URINE ANALYSIS AS A PREDICTOR OF URINARY TRACT INFECTION IN CHILDREN

Dissertation submitted to

THE TAMIL NADU DR.M.G.R MEDICAL UNIVERSITY

In fulfilment of the regulations for the award of the degree

M.D. PEDIATRICS

DEPARTMENT OF PEDIATRICS

PSG INSTITUTE OF MEDICAL SCIENCES & RESEARCH

THE TAMIL NADU DR.M.G.R MEDICAL UNIVERSITY

CHENNAI, TAMIL NADU

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CERTIFICATE

This is to certify that the thesis entitled**"URINE ANALYSIS AS A PREDICTOR OF URINARY TRACT INFECTION"** is a bonafide work of **Dr.SEENA JOHN**done under the direct guidance and supervision of **Dr. JOTHILAKSHMI**in the Department of PEDIATRICS, PSG Institute of Medical Sciences and Research, Coimbatore in fulfilment of the regulations of DR. MGR Medical University for the award of M.D degree in PEDIATRICS.

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DECLARATION

I hereby declare that this dissertation entitled**URINE ANALYSIS AS A PREDICTOR OF URINARY TRACT INFECTION IN CHILDREN** was prepared by me under the direct guidance and supervision ofmy Professor**Dr. JOTHILAKSHMI,** PSG Institute of Medical Sciences & Research, Coimbatore.

This dissertation is submitted to the Tamil Nadu DR. MGR Medical University in fulfilment of the University regulations for the award of MD Degree in PEDIATRICS. This dissertation has not been submitted for the award of any otherDegree or Diploma.

Dr.Seena John

CERTIFICATE BY THE GUIDE

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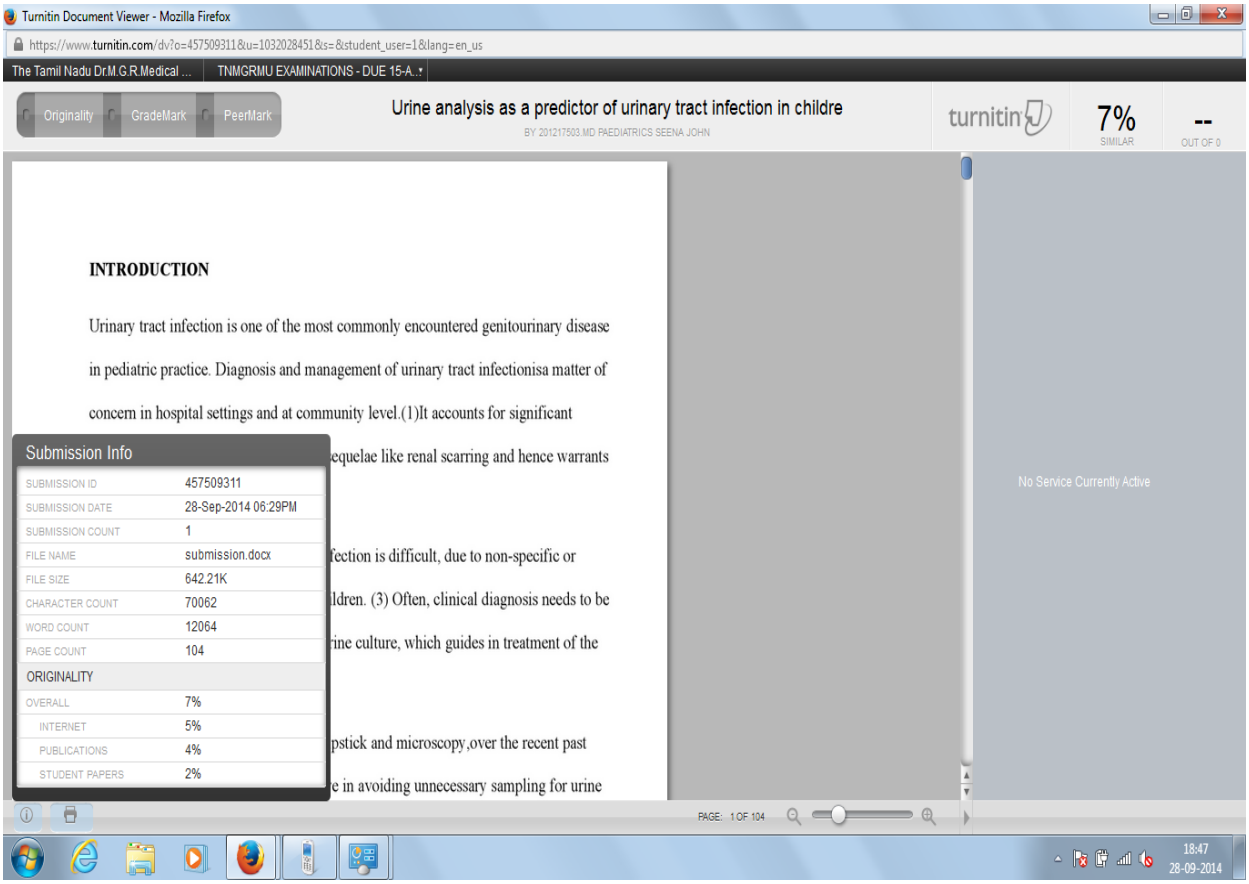
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CONTENTS

BACKGROUND

Urinary tract infection is one of the most commonly encountered genitourinary disease in pediatric practice. The clinical diagnosis of urinary tract infection is difficult, due to non-specific or vague symptomatic spectrum seen in children. Use of rapid diagnostictests like urine dipstick and microscopy,over the recent past was found to be economical and effective in avoiding unnecessary sampling for urine cultures.Although extensive pediatric studies have been done to evaluate the performance characteristics of these rapid diagnostic tests in rightly diagnosing a UTI, there is lack of sufficient studies and paucity of data on these in developing countries like India.

This study focuses on reliability of urine dipstick and microscopy in early detection of childhood urinary tract infection and the current status of urine analysis as an effective screening tool in an Indian set up. This study looks at the single as well as combination of parameters that provide maximum sensitivity and specificity, providing a better diagnostic criteria in detecting an underlying urinary infection.

OBJECTIVE:

To evaluate the usefulness of rapid diagnostic tests (dipstick and microscopy) in predicting urinary tract infection in children.

METHODOLOGY:

Urine samples were obtained under strict aseptic precautions for both, urine analysis and urine culture in 2 different containers. The samples for urine analysis and urine culture were sent to clinical pathology lab and microbiology lab respectively within 2 hours of collection. The decision to initiate an empirical treatment, pending the urine culture reports was left to the treating physician. Urine analysis was performed by a trained technician and urine culture was done by a lab technician, under supervision of microbiologist. The results obtained from urine analysis, which included both urine dipstick and microscopy were compared with urine culture. 6 parameters such as leukocyte esterase, pyuria, nitrites, bacteriuria, hematuria and albumin were compared with urine culture.

The results were divided into two groups- culture proven UTI and the sterile culture groups. The true positive, true negative, false positive and false negative values were obtained and specificity, sensitivity, positive and negative predictive value were calculated for all the 6 parameters, single and in combination in both the groups. The clinical profile of the patients who are confirmed cases of urinary tract infection were also studied. The initiated therapy by the treating physician

was either altered or continued after reviewing the antibiotic sensitivity pattern in the culture proven UTI cases.

RESULTS:

200 patients with suspected urinary tract infection were enrolled in the study. 100 patients with culture proven UTI and 100 patients with sterile urine cultures.

1. Among the culture proven UTI group, urine analysis was positive in 85 cases and negative in 15 cases. Urine analysis was positive in 33 cases and negative in 64 cases in the sterile culture group.
2. Leukocyte esterase has maximum sensitivity of 81%.
3. Nitrites has a maximum specificity of 99%.
4. There was no significant correlation between parameters and age in the culture proven UTI group, except for nitrites. Nitrites positivity significantly increased as age increases.
5. The combination of leukocyte esterase with pyuria and nitrites had the maximum sensitivity in this study.

CONCLUSION:

1. In predicting urinary tract infection, Nitrites and bacteriuria has a positive predictive value of 93.1% and a combined specificity of 95%.
2. In predicting urinary tract infection, Leukocyte esterase and nitrites has a combined sensitivity of 82% and negative predictive value of 83.3%.
3. In predicting urinary tract infection, Leukocyte esterase and bacteriuria has a combined sensitivity of 82%.
4. Hematuria and albuminuria, as single parameters has poor sensitivity, specificity and predictive values.
5. Nitrites positivity increases with age.

INTRODUCTION

Urinary tract infection is one of the most commonly encountered genitourinary disease in pediatric practice. Diagnosis and management of urinary tract infectionisa matter of concern in hospital settings and at community level.(1) It accounts for significant morbidity due to potentially dangerous sequelae like renal scarring and hence warrants an early and accurate diagnosis.(2)

The clinical diagnosis of urinary tract infection is difficult, due to non-specific or vague symptomatic spectrum seen in children. (3) Often, clinical diagnosis needs to be supported with confirmatory tests like urine culture, which guides in treatment of the infection.

Use of rapid diagnostic tests like urine dipstick and microscopy,over the recent past was found to be economical and effective in avoiding unnecessary sampling for urine cultures.These tests guides in selectively performing urine culture based on urine analysis reports,unless there is a strong clinical suspicion or if the patient has received antibiotics.(4) These tests were also helpful in initiating an empirical treatment in children with strong suspicion of UTI, while the urine culture reports are awaited.(5)Many studies have reported high specificity and sensitivity of dipstick tests, when used in combination with urine microscopy. (6)(7)These tests aid in early therapeutic intervention, thereby preventing complications.

Although extensive pediatric studies have been done to evaluate the performance characteristics of these rapid diagnostic tests in rightly diagnosing a UTI, there is lack of sufficient studies and paucity of data on these in developing countries like India.

This study focuses on reliability of urine dipstick and microscopy in early detection of childhood urinary tract infection and the current status of urine analysis as an effective screening tool in an Indian set up. This study looks at the single as well as combination of parameters that provide maximum sensitivity and specificity, providing a better diagnostic criteria in detecting an underlying urinary infection.

REVIEW OF LITERATURE:

TERMINOLOGY AND DEFINITIONS:

URINARY TRACT INFECTION:

Urinary tract infection refers to pathogenic (predominantly bacterial) colonization anywhere along the anatomical course of the urinary tract, (8)evidenced by significant bacterial growth of a single species on urine culture in the presence of clinical symptoms.

RECURRENT URINARY TRACT INFECTION:

The term recurrent UTI is used for patients who present with:

1. More than single episode of upper urinary tract infection or pyelonephritis

(or)

2. More than 2 episodes of lower urinary tract infections like cystitis

(or)

3. One episode of upper urinary tract infection and one episode of lower urinary tract infection.(9)

ATYPICAL / COMPLICATED URINARY TRACT INFECTION:

Evidence of urosepsis induced systemic features like high grade fever (>39°C), sick looking, vomiting, dehydration, palpable mass in abdomen or bladder mass with or without associated renal angle tenderness, poor urinary

stream, raised creatinine,failure to respond within 48 hours of initiation of antibiotic therapy, or growth of non- E.coli organisms in the urine culture.(9)

SIMPLE URINARY TRACT INFECTION:

UTI with low grade fever with urinary symptoms like urgency, increased frequency of micturition, dysuria along with absent clinical features of complicated UTI(9).

ASYMPTOMATIC BACTERIURIA:

Patient is asymptomatic but urine culture shows significant pathogen colonization growth.(10)

SIGNIFICANT BACTERIURIA:

Colony count of $>10^5$ CFU/ml of single species in a clean catch of midstream urine sample (or)

Colony growth of $>10^4$ CFU/ml in the presence of clinical features (or)

Colony growth of >50,000 CFU/ml in catheterized urine sample(9)

UPPER URINARY TRACT INFECTION:

Upper UTI refers to infection involving the kidneys, ureter or pelvis(9)

LOWER URINARY TRACT INFECTION:

Lower UTI refers to infection involving bladder and urethra(9)

CYSTITIS:

Bladder inflammation leading to symptoms like urgency, frequent micturition, pain in the supra pubic region, dysuria and urinary incontinence.(10)

PYELONEPHRITIS:

Infection involving the pelvicalyceal system and renal parenchyma resulting in fever,abdominal or loin pain and urinary symptoms(10)

VESICOURETERIC REFLUX

Retrograde urinary flow from the bladder into the upper urinary tract (ureter and renal pelvis)(10)

ACUTE LOBAR NEPHRONIA:

A localized bacterial infection involving more than1 lobe of the kidneys, representing a sequelae of pyelonephritis or a preceding event to development of renal abscess.It is also known as acute lobar nephritis.(10)

HISTORICAL PERSPECTIVE(11,12)

UTI has been found to be the third most common bacterial infection encountered in children.

The initial attempts at managing urinary tract infections began from the ancient Egyptian times, when herbal treatments were suggested by Ebers Papyrus to relieve urinary symptoms without any evidence of pathological basis. Hippocrates attributed cause of urinary disorders to the disharmony underlying the 4 humors.

Roman medicine elaborated on conservative approach to the management which included adequate bed rest, diet, herbal medicines and narcotic drugs. This was seconded by Greek physicians who also made ammendments in the invasive techniques like catheterization and lithotomy for urinary calculi. With introduction of uroscopy by the Arab physician Aetius, interpretation of the findings from the procedure and classification of UTI was made. The existing treatment options were further studied extensively and were refined during the Middle Ages with no newer advances. The early 19th century provided a detailed and well defined approach to the management of the disease although no attempts were made at discovering that UTI was caused by a variety of microorganisms. The ultimate discovery that microorganisms were responsible for causing UTI provided insights into researching the susceptible antibiotics and enhance development of better management strategies aimed at a causative focus. The discovery of anti-microbial agents during 20th century, to curb the infection was one of milestone advances in management of UTI,

In the past 30-50 years, though there is a significant reduction in mortality and morbidity, the natural course of urinary tract infection have undergone several changes due to the evolving drug resistant organisms since the introduction of antibiotics. This has highlighted the importance of evidence based approaches and strategies in the management of UTI.

EPIDEMIOLOGY

UTI remains one of the commonest infection encountered in children, following gastrointestinal and respiratory focus.(13,14,15) It accounts for about 5% of febrile illness among pediatric patients and should be strongly considered as a cause for nil localizing pyrexia, especially in under 5 children. More than 75% of children in the above age group, diagnosed with febrile UTI were detected to have pyelonephritis aided by nuclear and imaging studies.(13)(18)(19)(20)

Although extensive studies have reported a wide and varied prevalence rates from 3.3 to 37.5%,a true incidence and prevalence of the disease, especially in developing countries still remains unclear because of the under reporting of UTI cases due to the wide range of non-specific presentations and difficulties in obtaining urine specimen for laboratory evaluation.

It is not known how often UTI is the cause of illness in young children presenting in general practice-based primary care and which children should be targeted for urine sampling.

It accounts for 0.7% of office visits to physician and 5-14 % of emergency consults by children annually. (16)Most of the studies which have evaluated UTI in children are observational and hence the data from such studies are unreliable and inconclusive. Prevalence of UTI is largely dependent on the demographic data, especially the age and sex of the patient.

One of the largest pooled data on the prevalence of UTI which utilized the MEDLINE and EMBASE databases was by Sheikh et al which concluded that the highest prevalence of UTI was observed in males less than 3 months of age and females less than 12 months of age. (16)Among infants presenting with fever without any localizing examination findings, the prevalence of UTI was found to be 7 % but ranged from 2.1-8.7% depending on the age and sex. Infants below 3 months had the highest prevalence with rates of 20.1% in uncircumcised vs 2.4% in circumcised males with UTI.(16)

Ferrara P et al concluded that the prevalence rates differ according to age, sex and status of circumcision and the highest prevalence was observed in uncircumcised febrile infants <50 months of age.(17)

Although a general higher preponderance is observed in females than males, males commonly present with UTI in the neonatal and infancy period. Among the males, there is a higher risk associated with uncircumcised children as compared to circumcised. Female children tend to have higher incidence of UTI beyond infancy and peaks at school age. This is attributed to the short urethra and translocation of fecal contaminants.

Leroy S and Garvaix A reports that 6% of the girls and 2% of boys are diagnosed with atleast 1 episode of UTI before the age of 7 years. Asymptomatic bacteriuria is usually seen in 1% of infants,3% of preschool children and 1% of older children.(26)

Table 1

Prevalence of UTI according to different age groups (10)

Age group	Males	Females
< 1 year	0.2% -circumcised 0.7% -uncircumcised	0.1-0.4%
1-5 years	0.1 - 0.2%	1.4%
School age	0.04 - 0.2%	0.7 - 2.3%

Another study which reviewed prevalence of UTI according to age and sex distribution was by Bachur and Harper where highest prevalence was noted to be below 1 year of age among the males. Following infancy there was a shift to female preponderance as age progressed,(21)

Table-2

Prevalence of UTI in febrile children in various studies (18)(22)(23)(24)(25)

Different studies	Year	Prevalence of UTI
Hoberman et al	1993	5.3%
Schlager TA et al	2001	5.3%
Kaushal RK et al	2003	12.3%
Shaikh TA et al	2007	7%
Shaw KN and Gorelick et al	1999	5.4%

HOST AND AGENT FACTORS

HOST FACTORS:

1. **Obstructive Uropathy :**

Obstruction maybe either functional or mechanical. Mechanical obstruction refers to obstruction occurring anywhere along the anatomical course of the urinary tract like ureterocoele, urethral stricture, calculi and phimosis. Functional obstruction can occur in the form of neurogenic bladder. Obstructed urinary stream results in stasis due to impaired urinary flow and compromised defense mechanisms, providing a nidus for bacterial growth, thereby predisposing to urinary tract infections.

Obstructive pathology constitute to about 10 % of male children investigated for UTI.

2. **Culture medium :**

Urine itself acts as a good culture medium for bacterial growth because it lacks defence mechanisms. Unlike other body fluids like tears and saliva, lysozymes and immunoglobulins are absent in urine, which predisposes to infection. Urine also provides a suitable pH for growth of gram negative organisms especially Escherichia coli.

3. **Urethra :**

Females are at a higher risk for contracting urinary tract infection. Short urethra of females as compared to urethra of males is the attributable cause for acquiring urinary tract infection. The short urethra provides easy entry of organism into the urinary tract.

4. **Ureter :**

Dilatation of the ureter causes impaired peristalsis and ineffective emptying of the bladder leading to urinary stasis, facilitating bacterial growth and spread of infection to the kidneys. This explains the percentage of children who present with pyelonephritis without any persistent reflux.

5. **Kidneys:**

The migration of the polymorphonuclear cells is interrupted by the hyperosmolality of the damaged renal medulla, thereby reducing the phagocytosis. An increased number of receptors which adhere to ‘p’ fimbriated E.coli was seen in the renal medulla of patients with recurrent UTI.

6. **Periurethral Bacterial flora**

Periurethral flora in females, which predominantly includes lactobacilli prevent attachment of the virulent organisms to the epithelium.Antibiotic overuse can eliminate the normal flora, thereby predisposing to UTI.

7. **Circumcision**

Uncircumcised individuals are at increased risk of UTI than circumcised UTI because of prepucial growth of pathogens.

8. **Bacteriuria during pregnancy**

Rapid colonization of pathogens can occur to babies born to mothers with bacteriuria during pregnancy.

9. **Diabetes**

Diabetes Mellitus is said to have a known association with UTI in all age groups. They suffer from severe complications of UTI like fungemia and pyelonephritis.

10. Extrinsic factors

1. Catheterization
2. Broad spectrum antibiotic therapy

11. Vesicoureteric reflux

This is the most significant host factor in the etiology of upper urinary tract infection especially pyelonephritis. Children with UTI are at 3 times higher risk of developing renal injury as compared to those patients without reflux. Primary reflux occurs in association with other renal and genitourinary anomalies especially conditions like agenesis, dysplastic kidney and pelvi-ureteric junction obstruction.

Secondary VUR occurs secondary to increased pressure in the bladder like neuropathic bladder,non neuropathic bladder and bladder outlet obstruction.

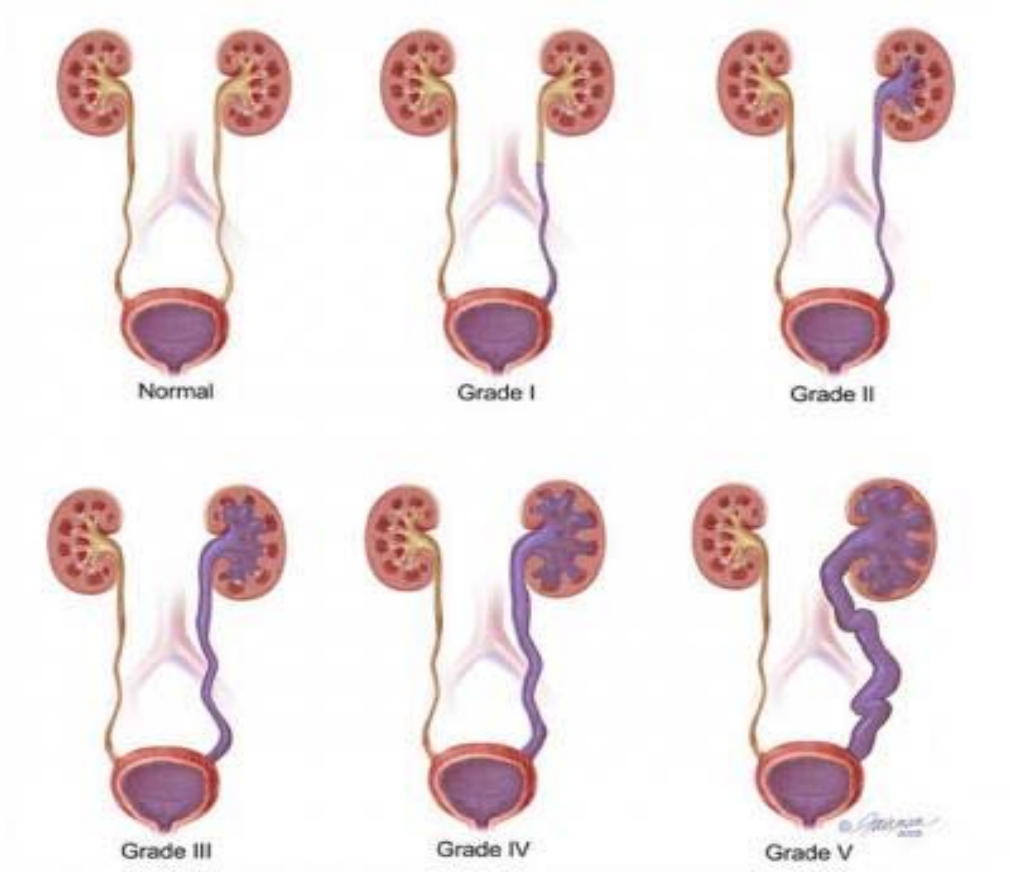
Inflammatory processes like bacterial cystitis, vesical calculi and foreign bodies can also cause secondary vesicouretericreflux.Pre-existing VUR can further worsen if the patient has bowel or bladder dysfunction. Severity of VUR is graded into 5 types.

Table 3:

Grading of VUR

Grades	Reflux
I	Reflux into the non dilated ureter
II	Reflux into upper collection system but without dilatation
III	Reflux into dilated ureter with/without blunting of calyceal fornices
IV	Reflux into grossly dilated ureter
V	Massive reflux, tortuous and dilated ureter along with loss of papillary impression

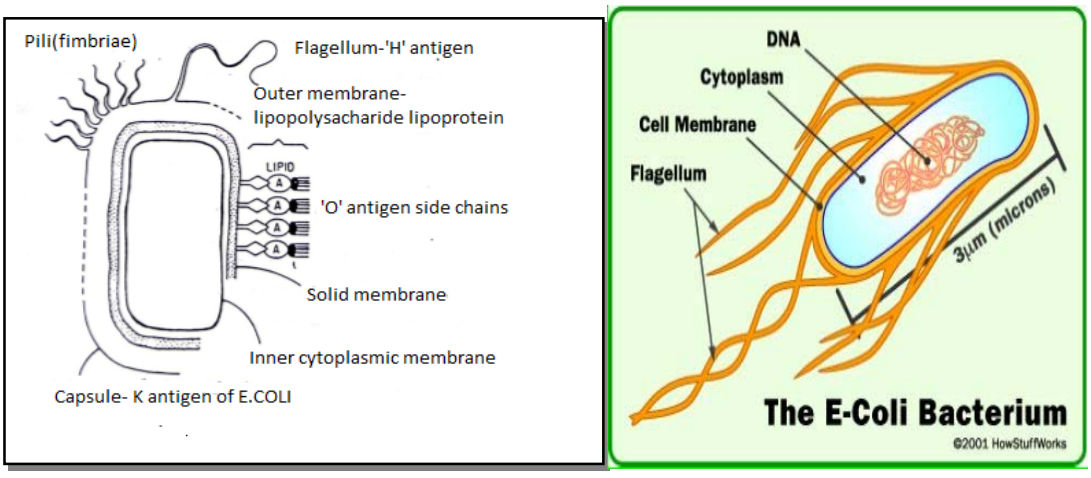
Fig:1: Grades of VUR



AGENT FACTORS:

Virulencefactors of the bacteria plays a vital role in the pathogenesis of urinary tract infections. The commonest causative organism of UTI is E.coli because of specific virulence factors which facilitate colonization in the uroepithelium. Although over 150 serotypes of E.coli have been identified, less than 10 serotypes are responsible for UTI. The identified virulence factors of E.coli include adherence to uroepithelial cells, hemolysin, colicin and other bacterial products that disrupt the cell membrane, K antigen present in the bacterial capsule, ability of bacteria to acquire iron (thereby increasing the bacterial survival) ,resistance to the bactericidal activity in the serum and capsular polysaccharides which inhibit the activation of alternate complement cascade.

Figure 2: Gram negative organism and its structure



1. **Adherence factors :**

By bacterial adherence, the components of the bacteria are introduced into the tissues of the urinary tract. This process is facilitated by various factors which are present on the bacterial strains. The uropathogenicE.coli possess proteinaceous hair like projections called the fimbriae or pili which enhances ability of bacteria to attach to the receptors of the host cell.These contain adhesins at the tip, which help n binding to the receptor after recognition of glycol phospholipid receptor. Following adhesion, there is activation of cytokines which further induces adhesin molecule production and leukocyte chemotaxis.

1. **Type II Fimbraie:**

Certain virulent strains of bacteria possess adhesion on the fimbria (type- II Fimbriae) which agglutinates RBCs of the P1 blood group and hence they are called P-Fimbriated E.coli. These strains are predominantly seen in pyelonephritis and less common in lower urinary tract infections.

2. **Type-1 Fimbriae :**

Transitional epithelial cells are coated with uroplakin receptors. The type-1 fimbriated E.coli attach and bind to the mannose component of the uroplakinreceptors. Thus there is continuous expression of the type-1 fimbriated E.coli in the strains responsible for

cystitis and hence the infection is confined to the bladder. In pyleonephritic strains, this expression of type-1 fimbriae is switched off.This allows the organism to ascend up the urinary tract, till kidneys. The renal epithelium contains digalactoside receptors to which, the ‘P’ fimbriated bacteria attaches.

3. **‘X’ Adhesins**

The ‘x’ adhesins have been found to facilitate attachment of the E.coli to the renal parenchymal cells.

2. **O and K antigens:**

K antigen present on the bacterial capsule protects bacteria from phagocytosis and complement inactivation.The lipopolysaccharide endotoxin ‘O’ antigen is responsible for inducing inflammation and fever.

3. **Hemolysin:**

Few strains of E.coli produce cytotoxic proteins called hemolysin

4. **Colicin:**

E.coli also produce antimicrobial proteins associated with increased virulence, which are toxic to other E.coli and related bacteria.This enhances the ability of the organisms to resist defense mechanisms of the host.

5. **Iron Binding capacity:**

   E.coli strains contain aerobin, an iron binding protein which helps bacteria in acquiring iron, required for their survival and metabolism.

6. **Urease**

   Organisms like Proteus possess mechanisms for producing renal damage due to production of urease.

7. **Motility**

   Bacteria contain pili or fimbriae which facilitates entry of organism into the uroepithelium by adhesins present at the tip.It also helps in spread of infection by aiding the bacterium to ascend up the urinary tract.

HOST DEFENSE FACTORS:

1. The ability of the bladder to intermittently and effectively empty the urine is a protective mechanism as this reduces the chances for stasis and bacterial overgrowth.
2. Extremes of pH,osmolality and high urea concentration inhibits the bacterial growth in the urinary tract.
3. Normal bladder is covered with a thin layer of mucopolysaccharide that is produced by the transitional epithelium. Bacteria must penetrate this layer for its attachment to specific uroepithelial cells.

4. Tamm Horsfall Proteins, which are secreted by the loop of Henle, traps the type-1 fimbriatedE.coli, inhibiting its attachment to the urinary epithelium.
5. Circumcision helps in preventing the chances of urinary tract infection as the prepucialcolonisation of bacteria. Early circumcision is found to be associated with lower incidence of UTI.
6. Breast feeding is said to have a protective effect during the first 6 months of life, since it stabilizes the normal flora and prevents attachment of pathogenic bacteria to the urinary epithelium due to secretion of anti adhesive factors in the breast milk.

PATHOPHYSIOLOGY

The urinary tract can get infected in the following ways:

1. Retrograde infection: When there is ascent of infection from the fecal or perineal bacteria.
2. Nosocomial infection: When bacteria is introduced via invasive procedures including catheterization.
3. Sepsis: When there is a systemic or parenteral infection.

The most commonly acquired mode of urinary infection is by retrograde ascent because most of the bacteria infecting the urinary tract comes from the

bowel of the host. When there is vaginal or periurethral colonization and seeding of the bacteria, pathogens from the bowel enter the urinary tract.

MODES OF SPREAD:

Bacteria can enter the genitourinary system by the following modes:

1. **Ascending:** As a result of poor hygiene, urinary infection can be acquired from the surrounding meatal area.
2. **Hematogenous:** This mode of spread is usually seen in children with an immunocompromised state or in neonates with an immature immune system.
3. **Lymphatic:** Infection can be acquired from colonic, rectal and periurethral lymphatics.
4. **Direct Extension**: It can occur in the presence of fistulas to any part of the urinary tract.

During the neonatal period, hematogenous spread commonly occurs leading to infection of the renal parenchyma, whereas pyelonephritis usually follows systemic sepsis. At all other circumstances, UTI is mostly the result of ascending mode of spread.

Normally, the papillae of the kidney possess anti reflux properties that prevent retrograde spread of urine into the collecting tubules. A few compound papillae allow intrarenal reflux which causes the urinary infection to trigger an immunologic and inflammatory cascade, which leads to resultant renal injury

and scarring. Following intrarenal reflux of bacteria, endotoxin of the bacteria causes release of granulocytes. These granulocytes can either aggregate and obstruct the capillaries causing renal ischemia or can cause bacterial phagocytosis, thereby releasing superoxide with destroys the tubular cells, interstitial inflammation, micro abscesses all leading to renal scarring.

ETIOLOGY:

Although UTI maybe caused occasionally by viruses and to a lesser extent by fungi, majority of the urinary tract infections are caused by bacteria. Fungal infection are found to exclusively occur in hospitalized patients. The extent and severity of UTI is largely dependent on:-

1. Inoculum size of the introduced bacteria
2. Virulence factors of the infecting bacteria\
3. Host resistance or defense factors

Most common causative organisms emerge from the facultative anaerobes that constitute bowel flora.

Bryan CS reported in his study that the most common uropathogen responsible for community acquired UTI is E.coli.

Other organisms causing community acquired infection Proteus, Klebsiella and Staphylococcus saprophyticus.

Arvind Bagga et al reported that E.coli was solely responsible for causing 90% of children with first episode of symptomatic UTI and 70% of recurrent

UTI. Among the Indian studies, Choudhury Payel et al(45) studied a drug resistance pattern in Eastern India where E.coli was the predominant uropathogen studied

Table 4 : Causative organism include

Gram positive rods	Escherichia coli Klebsiellasp Citrobacter Enterobacter sp Morganella morganii Proteus sp Gardenerella vaginalis Pseudomonas aeruginosa Serratiasp Providenciastuartii
Gram negative rods	S. aureus Staphylococcus epidermidis Staphylococcus saprophyticus Streptococcus group D Streptococcus fecalis Streptococcus group B Streptococcus fecalis
Gram negative cocci	Neisseria gonorrhoea
Other pathogens	Ureaplasmaurealyticum Mycoplasma Chlamydia trachomatis

Chris H et al stated that the commonest isolated organisms that are responsible for causation of UTI included gram negative, enteric organisms especially E.Coli., followed by Enterobacter,Klebsiella and Proteus.(31)

Neonatal UTI was commonly caused by Group B streptococci. Zorc et al evidenced in his study that around 80% of the total UTI cases were caused by E.Coli.,followed by Klebsiella,Enterobacter, Citrobacter and Pseudomonas(27). Jacobsen et al reported that E.Coli constituted to the most commonly isolated organism among community acquired UTI as well as nosocomially acquired UTI especially Bladder catheterization.(28)

Nowell et al reported that 141 infants had atleast 1 episode of UTI and 9% of the 141 infants had recurrent UTI .Commonly identified organisms were coagulase negative Staphylococcus ,E.coli, Enterococcus s,Klebsiella sp. Which were identified in 28 %, 12% and 17 % respectively.(29)

Mortality was caused by 9% of gram negative organisms as compared to 6 % of Gram positive organisms. Candidial UTI contributed to 21% of UTI as compared to 7% of bacterial UTI.

Saadeh SA and Mattoo TK et al reported that E.coli was the most common organism causing UTI in 60-92% of children.(30)

EXTENDED SPECTRUM BETA LACTAMASE PRODUCING BACTERIA IN CHILDREN:

The increased incidence of resistant Gram negative organisms causing UTI has been a major concern over the recent past. Beta lactamase production by the Gram negative bacteria is the vital contributor in inducing bacterial resistance to drugs. This further hinders the treatment of UTI with traditional antimicrobial therapy. Treatment is complicated due to the increasing worldwide incidence of ESBL production.

The existing evidence of published data on the magnitude of ESBL growth in urinary infection in local settings is unreliable and limited. A retrospective study done by John Dotis et al concluded that there was a higher incidence of ESBL UTI in patients who receive antibiotic prophylaxis and patients who had associated genitourinary anomalies.(32)

They also noted that children who had ESBL UTI had abnormal DMSA scan complicated with renal scar and prolonged hospitalization.

Kizilca O et al studied 344 patients with UTI and reported that the commonest organism was E.coli out of which 41.4% were ESBL producing. Among the Klebsiella species, 53.2% were Klebsiella ESBL species.(33) The probable risk factors for ESBL producing bacteria identified in the study were age below 1 yr and antibiotic prophylaxis,especially with cephalosporins.

The above studies support that E.coli has remained the commonest causative organism of UTI,at both community level and nosocomial infection over the years with a more inclination to extended spectrum beta lactamase E.Coli emergence due to the antibiotic resistance and overuse.

CLINICAL FEATURES

Signs and symptoms of urinary infection depend on:

1. Age at presentation

2. Anatomical location of infection

3. Severity of infection

1.Age at presentation:

1. **Neonates and Infants:** Neonates and infants with UTI usually develop UTI following septicemia.
    1. Hypothermia
    2. Hyperthermia
    3. Failure to thrive
    4. Vomiting
    5. Diarrhoea
    6. Irritability
    7. Sepsis
    8. Lethargy

9. Jaundice
10. Malodorous urine

2. Toddler

1. Vomiting
2. Diarrhoea
3. Abdominal pain
4. Abnormal voiding pattern
5. Malodorous urine
6. Inadequate weight gain

3. School age :

1. Dysuria
2. Abdominal pain
3. Dysfunctional / abnormal voiding pattern like secondary enuresis / incontinence
4. Constipation
5. Dribbling
6. Frequent micturition
7. Urgency
8. Malodorous urine

4. Adolescent

1. Dysuria
2. Abdominal discomfort
3. Burning micturition
4. Frequent micturition
5. Fever
6. Malodorous urine

There are various factors that are associated with increased occurrence of UTI like:-

1. Females(due to short urethra)
2. Uncircumcised male(prepucial colonization)
3. Vesicoureteric reflux
4. Toilet training
5. Obstructive uropathy
6. Instrumentation
7. Wiping of the genital tract from back to front
8. Tight undergarments
9. Constipation
10. Anatomical abnormalities of the genitourinary tract
11. Neuropathic bladder

SPECIFIC PHYSICAL EXAMINATION FINDINGS IN UTI

1. Abdominal palpation in suspected UTI may reveal renal masses, palpable or distended bladder or loaded fecal matter.
2. Examination of the spine and neurological evaluation is mandatory. External markers of neural tube defects must especially looked for.
3. Genitourinary examination must be done to look for related risk factors like phimosis and labial adhesions.
4. Height, weight and vitals including blood pressure must be measured as this gives clues to any underlying chronic renal compromise and obstructive uropathy.

Anatomic Location of infection:

1. CYSTITIS:

Urinary infection can be termed as lower urinary infection when there is bladder involvement. Bladder and urethral inflammation results in dysfunction of bladder and voiding disturbances. This produces predominantly urinary symptoms like urinary frequency, urgency, incontinence etc. Cystitis uncommonly causes fever. It is also termed as uncomplicated urinary infection since cystitis does not result in renal dysfunction and injury.

2.PYELONEPHRITIS:

Unlike cystitis, in pyelonephritis fever maybe the sole symptom. Due to the primary involvement of renal parenchyma, pyelonephritis is also termed as upper urinary tract infection or complicated UTI. More commonly found in newborn, pyelonephritis occurs following sepsis. Hence a varied symptomatic spectrum is seen in pyelonephritis from non – specific symptoms like poor feeding, vomiting, lethargy to features of systemic multi organ involvement like fever, jaundice, seizures are seen.

Renal abscesses are formed in pyelonephritis. These renal abscesses maybe cortical / corticomedullary, intrarenal abscesses or perinephricabscess. These produces symptoms like fever, flank pain, tenderness, hematuria and urinary symptoms like dysuria, frequency, urgency, nausea and vomiting.

Asymptomatic bacteriuria may occur when the child is asymptomatic but has a significant growth in the urine culture. This usually occurs in setting where children do not have any associated anatomical abnormalities.

Wettergen et al studied 37 infants, who had urine culture proven growth in the absence of the symptoms. These infants were untreated as there were no evidence of renal dysfunction or symptoms. On follow up, only one child developed pyelonephritis.

Schlager et al studied and reported asymptomatic bacteriuria seen in children who undergo clean intermittent catheterization.(23)

This entity has not been reported to have any associated renal dysfunction. However if asymptomatic bacteriuria is associated with any urinary tract malformation, follow up is recommended even though prompt antimicrobial therapy may be witheld.

RENAL SCARRING:

Upper /complicated urinary tract infection is associated with irreversible damage of the renal parenchyma leading to renal scarring. Studies report that renal scarring is seen in 10-30% of children following UTI. The following are the identified risk factors which cause renal scarring:

1.Vesicoureteric reflux

2.Obstructiveuropathy

3.Recurrent UTI

4.Untreated UTI or delay in prompt treatment

Orellana et al reported a higher incidence of renal scarring and dysfunction in children with non-E.coli UTI. Smellie et al found that younger children were at a higher comparable risk as compared to older children which suggested that younger kidneys were prone to renal damage.

A relationship between renal damage, pediatric UTI and resultant hypertension has been established by long term studies. Probable mechanisms suggested were the effects of renal angiotensin system and by atrial natriuretic peptide.

End stage renal disease although uncommon is a recognized complication of UTI and is an important cause for dialysis and renal transplantation. Jacobson and colleagues followed up 30 children who had focal renal scarring for a period of 27 years, out of which 3 children developed diffuse scarring and end stage renal disease. The above studies reinforce the need for periodic evaluation in children with UTI.

RECCURENT UTI

Recurrent UTI is yet another matter of concern in routine clinical practice. Recurrent UTI may further classified as

1. Unresolved bacteriuria
2. Bacterial persistence
3. Reinfection

Bacterial persistence and bacterial re infection follows a laboratory evidence of sterile urinary culture. Bacterial persistence occurs when the primary focus of infection is inadequately treated. Hence urine cultures will report the same bacterial isolations of the primary infection.

The uropathogen thrives frequently in a site that is masked from the antimicrobial therapy. These shielded sites refer to structural pathologies which include infected urinary calculi, foreign body, papillary necrosis or introduction of infected catheters or ureteral stent. Prompt identification is mandatory to eradicate the nidus of infection.

Reinfection occurs when pathogens different from the primary infection are isolated in the present UTI. In this case UTI follows periurethral colonization and ascent of fecal contaminants.

DIAGNOSIS

Since clinical diagnosis of UTI is difficult to rely upon due to the clarity of specific clinical features, laboratory evidence is required to confirm the infection.

Investigation modalities include-

Supportive evidence

Specific investigations

Imaging for complications

1. NON-SPECIFIC INVESTIGATIONS:

An acute renal infection is evident by presence of neutrophilic leukocytosis in complete hemogram and elevated acute phase reactants like ESR and CRP. An elevated total counts >20,000-25,000 cells/cu.mm suggests an underlying renal abscess. A probable sepsis must also be considered in neonates and infants. Hence a blood culture must also be obtained prior to initiating antimicrobial therapy.

2. SPECIFIC INVESTIGATIONS :

URINE ANALYSIS

Although not gold standard, urine analysis, which includes dipstick and microscopy, is useful in predicting urinary tract infection in children. It offers to be a rapid diagnostic test, cost effective and reliable in ruling out negative samples.

There has been an inclination towards determining efficacy of urine dipstick and microscopy over the recent past. Although comparisons of parameters have been done in the past in numerous studies, only few studies have evaluated the wide range of prevalence in each scenario, on which reliability of test depends and thereby varies.

Bachur and Harper et al studied the performance characteristics of rapid tests and concluded that the sensitivity of urine analysis was 82% and specificity of 92%(21).

Gorelick and Shaw et al suggested that combination of leucocyte esterase and nitrites in children, along with gram stain was superior to microscopic pyuria in detecting UTI(18).

A meta analysis was done by Huicho et al and colleagues, which included and reviewed a bigger number of articles. This study concluded that pyuria>10 cells/hpf and bacteriuria were better predictors in diagnosing UTI in children. Another meta-analysis done by Gabrielle J Williams was done to effectively analyse the sensitivity of urine analysis in detecting UTI in children, thereby selectively performing urine culture, reducing the laboratory work load and guide in starting an empirical therapy.

This study concluded that gram stain and microscopic detection of bacteria in the urine were best parameters which had good sensitivity and specificity (except for nitrites) as compared to all other parameters single and combination. The study also suggested that rapid diagnostic test was insufficient in identifying all childhood UTI cases.

Recent studies suggested that urine analysis is effective in ruling out UTI in the setting of low clinical suspicion and in cases were culture report are not reliable due to prior antimicrobial use.

DIPSTICK VS MICROSCOPY

A recent study by Eric et al and colleagues compared the efficacy of dipstick and microscopy for screening UTI in 13,030 febrile infants which concluded that dipstick was the best screening and has equal performance characteristic compared to microscopy and dipstick combined together.

DIPSTICK ANALYSIS

LEUKOCYTE ESTERASE:

Leukocyte esterase refers to enzymatic remnant of the white blood cells. It is predominantly found in granules of the azurophilic neutrophil. These granules possess proteins that exhibit esterolytic activity. This reacts with an impregnated reagent to produce a positive result of blue colour. Since the neutrophils are labile, leucocyte esterase denotes enzymatic remnants of cells which are not visible microscopically.

A positive leukocyte esterase, thus denotes presence of significant number of neutrophils- either intact or lysed. Leukocyte esterase catalyzes hydrolysis reaction to produce respective alcohols and acid components.

False negative results can occur in:

1. Altered specific gravity, protein and glucose
2. Boric acid
3. Antibiotics like tetracycline, cephalexin, cephalothin
4. High ascorbic acid content

False positive results can occur in:

1. Contaminated urine with vaginal secretions
2. An alternative for cellular sources of esterase
3. In the presence of formalin and oxidizing agents

NITRITES:

Gram negative bacteria especially E.coli reduce dietary nitrates to nitrites. Atleast a minimum duration of 4 hours of urinary stasis is required for action of bacteria to breakdown nitrates.

Hence although nitrites are less sensitive in detecting UTI due to the above reasons, the presence of nitrites in a fresh urine sample is highly specific for an underlying UTI.

False positive results can also occur if there is delay in testing the sample or in case of long standing samples.

The reagent impregnated on the nitrite dipstick is highly sensitive to air, so containers should be closed immediately after use. After one week of exposure, one third of strips gave false positive results.Non-nitrate–reducing organisms and patients who consume a low-nitrate in their diet may give a false-negative results.

MICROSCOPIC EXAMINATION

Importance of Microscopic examination of urine in detecting UTI is still a matter of controversy.A centrifuged urine specimen contains all the components which have accumulated during the filtration.

Cellular elements are from two sources:

1. Desquamation/exfoliation of the epithelium lining the tubules and the urinary tract.
2. Cells which are of hematogenous origin like leucocytes and red blood cells.

PYURIA

Pyuria is the microscopic examination of urine sample for visible leucocytes which are seen per high power field. Among various components like casts, crystals, Rbcs etc, the most reliable parameter in detecting UTI by microscopic examination is pyuria. The number of pus cells/hpf depends on whether the urine specimen is centrifuged or uncentrifuged.In a centrifuged sample,pus cells of >5cells/hpf is considered as significant, whereas leucocytes of >10 cells/hpf is significant in an uncentrifuged specimen. False negative results may occur, if there is external contamination while collecting the specimen.

Kagan Huysal and colleagues reported that among the various parameters studied both by dipstick and microscopic analysis, the evidence of pus cells or leucocytes detected in urine samples, indicated a probable inflammatory response in the urinary tract. The analysis showed that leukocyturia proved to be a better parameter as compared to bacteriuria.

False negative results may occur during cell lysis. The presence of few or no pus cells is consistent with low likelihood of UTI.

BACTERIURIA:

Detection of bacteria in urine is yet another parameter which is measured to exclude urinary infection. Although there are many methods which are used to study the bacteriuria, one of the reliable methods are using flow cytometry.

False negative results may occur when cellular debri is falsely interpreted as bacteria.

One must also remember that although cultures detect only the live bacteria, both live and killed bacteria are picked up by analyzers thereby increasing the chances for a falsely positive bacteriuria.

HEMATURIA AND ALBUMINURIA:

Although either of these parameters maybe tested positive in a UTI, a definite diagnosis based on the two parameters alone cannot be relied upon due to high chances of false positivity. A hematuria/ albuminuria may suggest an active renal involvement and may require further evaluation.

Table 5:

AAP data on sensitivity and specificity of parameters of urine analysis(34).

Test	Sensitivity	Specificity
Leukocyte esterase	83(67-94)	78(64-92)
Nitrites	53(15-82)	98(90-100)
Either Leukocyte esterase/ nitrites positive	93(90-100)	72(58-91)
Microscopy(WBCs)	73(32-100)	81(45-98)
Microscopy(Bacteria)	81(16-99)	83(11-100)
Leukocyte esterase or nitrites or microscopy positive	99.8(99-100)	70(60-92)

URINE CULTURE:

Urine culture has remained gold standard for the diagnosis of symptomatic urinary tract infection as well as for diagnosis of asymptomatic bacteriuria.

Urine culture gives us information about the organism grown, if the growth of uropathogen is significant to cause urinary infection and the likely susceptible antibiotics. It gives us an opportunity to revise or confirm our diagnosis and alter the line of management if the current treatment involves use of resistant antibiotics.

The results of urinary culture must be however interpreted with caution because these maybe altered by :

1. Technique of urine collection
2. Prior use of antibiotic
3. Improper or faulty laboratory techniques

Technique of urine collection: An early morning of fresh sample is ideal although it is not always practically possible.

There are various methods of urine collection:

Bag method

Midstream clean catch

Suprapubic aspiration

Catheterized sample

The preferred method out of all the above methods is suprapubic aspiration among the invasive methods since there is increased risk of introduction of bacteria by catherization.

Among the non-invasive methods,mid stream clean catch urine is the preferred method of urine collection for culture. However this is not routinely preferred as there is high risk of contamination with periurethral flora especially in males, since there is high risk of prepucial contamination.

Bag method is not reliable in detection of UTI due to the high risk of contamination in bagged specimens and thereby high rates of false positive

results. However it is useful in ruling out negative samples but its not useful in documenting UTI in the absence of clinical supportive evidence.

RECOMMENDATIONS BY VARIOUS GUIDELINES ON METHOD OF URINE COLLECTION

NICE guidelines suggests that non invasive method of urine collection is practically acceptable. Although midstream is the preferred method of urine collection, methods such as urine collection pads and bag method are also acceptable according to NICE guidelines. Invasive methods are used only if the non invasive method of urine collection fails.

The preferred method of collection of urine for culture by AAP is suprapubic aspiration and catheterized methods. Bag and midstream clean catch method is not recommended by AAP.

IMAGING FOR COMPLICATIONS:

Ultrasound Abdomen:

It is a simple and easy to perform non-invasive procedure which gives an outline of the renal morphology or any associated genitourinary anomalies like ureterocoele.

Changes which take place in the bladder like trabeculations and thickening of bladder wall are detected on ultrasound.However the chances of detecting an acute pyelonephritis is less(30%) by demonstrating an enlarged kidney on ultrasound. Conditions like pyonephrosis requiring drainage by

percutaneous nephrostomy are detected on ultrasonogram. It is less reliable in detecting VUR and renal scarring. Assesment of renal parenchymal scarring can be done through periodic ultrasound scans after a follow up of atleast 2 years. Functional abnormalities of the bladder and urinary retention syndrome can be detected in older children by evaluation of post void bladder volume.

Caleb P, Emilie, K Johnson and colleagues studied around 2259 patients with UTI who were below 60 months of age on whom renal bladder ultrasound.They concluded that RBUS is a poor screening test for genitourinary abnormalities, with low sensitivity/specificity.

A negative RBUS does not rule out significant genitourinary anomalies or pathology (particularly VUR grades III and higher), whereas a positive RBUS is a poor predictor. In such children, RBUS and VCUG should be considered as additive tool in providing important information on the anatomy.

Hoberman et al studied the renal and bladder ultrasonogram of 309 children with febrile UTI. He reported VUR, especially higher grades of VUR were under-reported in ultrasonogram. He thus concluded that validity and performance charateristics of renal ultrasonography as a screening tool for identifying children with genitourinary anomalies require further evidences to support guidelines laid down by AAP.

INTRAVENOUS PYELOGRAPHY

Intravenous pyelography involves injection of the contrast medium through the cannula, after which the dye is excreted via the blood stream.Thus the dye becomes visible on the Xray after immediate administration.

A series of sequential XRays are taken to capture the dye as it travels through various parts of the urinary system.Intravenous pyelography provides a comprehensive overview of anatomy of renal and the urinary tract. Disadvantages of Intravenous pyelography is associated with risk of allergic reaction to the contrast which is administered iv and increased radiation exposure ,it is contraindicated in cases of impaired renal function and neonates interpretation of renal function depends on the image quality to a great extent.

MICTURATING CYSTOURETHROGRAM

Lower urinary tract abnormalities such as uretrocele , posterior urtheral valve and diverticulum are best detected by a retrograde voiding cystourethrogram, it is also the most reliable method for demonstration of VUR. However VCUG is often associated with risk of radiation exposure need for bladder catheterization and risk of introduction of bacteria in to the urinary tract for the procedure.

This procedure can also done as OPD. An XRay prior to catheterization is taken after which bladder is catheterized under strict aseptic precautions. The bladder ix then injected with the dye material. The filling of the bladder and the

urination is monitored by radiologist and simultaneous fluoroscopic images are taken. There has been varied opinions regarding performing VCUG during the infection versus following clearance of infection. Recent recommendations suggest imaging to be done during the infection as there can be delay in detecting patients with renal scar thereby contributing to morbity.

DMSA

DMSA involves nuclear medicine to perform renal scan. A radioisotope called technetium 99m DMSA is injected into the vein. The patient is asked to wait for 4-5 hours. This time period is allowed so that the kidneys absorb the injected material. The patient is then asked to void urine, following which images are taken. The average imaging time is around 15- 20 min.

DMSA scan is best for evaluating patients with acute pyelonephritis. In DMSA, the involved areas of the kidney are typically photopenic and the kidney is enlarged.DMSA scan is positive in 50 % of the febrile patients.Among those positive, renal scarring is detected in 50% and the remaining have acutely positive scans which normalize over a period of time.In patients who have a DMSA scan with more than or equal to grade III reflux. The DMSA scan reflux is usually consistent with Acute Pyelonephritis. Longitudinal studies have been done on children with lower grade reflux and found to normalize on follow up. CT is another diagnostic tool which can image Acute Pyelonephritis. But it is often withheld due to higher risk of radiation.

TREATMENT

Prompt treatment of cystitis is essential to prevent the progression and spread of iunfection to cause pyrelonephritis. In case of severe infection and symptoms,an empirical treatment must be initiated and then the treatment can be altered or continued depending on the urine culture reports.In case of milder symptoms, antimicrobial therapy can be delayed till culture reports are obtained.

In cases of initiation of empirical therapy, the preferred choice of antibiotic is trimethoprim sulfamethoxazole as this antibiotic is effective against most strains of E.Coli.

Nitrofurantoin is also preferred and has an added advantage of being effective against Klebsiella and Enterobacter species.

Amoxicillin has also been recommended for the initial treatment although no specific advantages over the other 2 drugs have been found.In acute illnesses in febrile children, suggesting a probable pyelonephritis, atleast a 10-14 day course of the antibiotic therapy (preferable broad spectrum antibiotics) which reach significant tissue levels are suggested.Criteria for admission includes-

1. Children who are dehydrated
2. Persistent vomiting
3. Poor feeding
4. Children <1month of age
5. Suspected urosepsis

Preferred IV antibiotics include ceftriaxone/cefotaxime/ampicillin in combination with an aminoglycoside like gentamycin.Side effects of aminoglycosides like ototoxicity s=and nephrotoxicity must be kept in mind. Renal function especially serum creatinine must be obtained prior to starting aminoglycosides.

Aminoglycosides are also effective against Pseudomonas and its effectiveness in the urinary tract is increased by alkalinazation of the urine.Oral 3rd generation cephalosporins are as effective as parenteral antibiotics like ceftriaxone in acting against gram negative organisms .Nitrofurantoin should not be routinely used in children with febrile UTI as this drug does not reach significant renal tissue levels.

Ciprofloxacin is also useful as an oral antibiotic especially for resistant organisms particularly Psudomonas.infection. However routine clinical use of fluoroquinolones should be limited due to potential risk of associated cartilage damage.

Few children may respond to an initial dose of intramuscular injection of ceftriaxone loading dose followed by oral 3rd generation cephalosporins.

A urine culture, although not routinely recommended is done 1 week after completion of antibiotic course is useful in demonstrating the clearance of infection and justification for discontinuation of antibiotics.

Children with a nephric /perinephric abscess or who have an infected obstructive uropathy might require surgery or other invasive interventions like percutaneous drainage.Identification of any predisposing factors for developing recurrent UTI must be assessed.Recurrent UTI can be prevented if school age children with voiding dysfunction are identified. Few children may develop infrequent voiding and constipation.Parents of such patients must be constantly counseled and more normal patterns for voiding must be adopted by the patient. Prophylaxis especially with trimethoprim sulfamethoxazole or nitrofurantoin may be given. Other antibiotics preferred for prophylaxis include amoxicillin and cephalexin.But these antibiotics must be administered with caution as a prophylaxis as there is a higher chance of inducing bacterial resistance.

There still lies controversies regarding the use of prophylaxis in children with low grade or no reflux as there is higher risk of acquiring bacterial resistance and inadequately treated recurrent urinary infections.

Other conditions where urinary prophylaxis is recommended includes neurogenic bladder, obstructive uropathy,conditions causing urinary stasis, reflux and calculi.

Recent interest has been focused on the use of probiotics in reducing the uropathogenic flora and cranberry juice which prevents UTI by inhibiting bacterial adherence through formation of biofilm.The main complications include arterial hypertension and end stage renal disease.

Table 6: Dosage of antibiotics

Antibiotic(10)	Dosage
Nitrofurantoin	5-7mg/kg/day in 3-4 divided doses
Amoxicillin	50mg/kg/day
Inj.Ceftriaxone	50-75mg/kg/day
Inj.Cefotaxime	100mg/kg/day
Inj.Ampicillin	100mg/kg/day
Inj.Gentamycin	3-5mg/kg/day in 1-3 divided doses

AIMS AND OBJECTIVES

OBJECTIVE:

To evaluate the usefulness of rapid diagnostic tests (dipstick and microscopy) in predicting urinary tract infection in children.

MATERIALS AND METHODS:

This study was conducted in Department of Pediatrics, PSG Hospitals from May 2013 to August 2014. 200 patients with suspected urinary tract infection, attending outpatient department or admitted in the hospital were included in the study.

INCLUSION CRITERIA:

Children aged 1month to 16 years, suspected to have urinary tract infection.

EXCLUSION CRITERIA:

1. Patients who have received antibiotics within 48 hours of hospital visit.
2. Patients who are known case of congenital genitourinary abnormalities.
3. Patients with recurrent UTI.

STUDY DESIGN:

Prospective study of evaluation of screening test

METHODOLOGY:

Urine samples were obtained under strict aseptic precautions for both, urine analysis and urine culture in 2 different containers. The methods of urine collection adopted for the study were bag method, catheterized and mid stream clean catch sample. The samples for urine analysis and urine culture were sent to clinical pathology lab and microbiology lab respectively within 2 hours of collection. The decision to initiate an empirical treatment, pending the urine culture reports was left to the treating physician. Urine analysis was performed by a trained technician and urine culture was done by a lab technician, under supervision of microbiologist. The results obtained from urine analysis, which included both urine dipstick and microscopy were compared with urine culture. 6 parameters such as leukocyte esterase, pyuria, nitrites, bacteriuria, hematuria and albumin were compared with urine culture.

The results were divided into two groups- culture proven UTI and the sterile culture groups. The true positive, true negative, false positive and false negative values were obtained and specificity, sensitivity, positive and negative predictive value were calculated for all the 6 parameters, single and in combination in both the groups. The clinical profile of the patients who are confirmed cases of urinary tract infection were also studied. The initiated therapy by the treating physician was either altered or continued after reviewing the antibiotic sensitivity pattern in the culture proven UTI cases.

SAMPLE SIZE:

Sample size estimation was done using the formula:-

$4 * p * q/d^2$

=4*80*20/100

(p=80- average sensitivity and specificity of all 6 parameters calculated from the reference data by AAP)

(q=100-P=100-80= 20)

(d-precision=10)

= 6400/100

= 64

Sample size was taken as 100 patients in each group, for better outcome and considering the average number of patients, diagnosed with 1st episode of UTI per month in the hospital (~ 4-5 patients/ month)

SAMPLING METHOD:

Consecutive sampling till the desired sample size was reached.

DETAILS OF THE TEST PROCEDURE:

METHOD OF COLLECTION OF URINE:

10ml of fresh urine sample was collected in all children. Early morning first void specimen was obtained in older children to achieve a concentrated specimen. The methods adopted for obtaining urine sample were bag, catheterized or midstream clean catch sample.Bag method was preferred in infants, especially female infants. Midstream and catheterized method was adopted for co-operative and older children.

BAG METHOD

The infant is placed on his/her back. The genitalia and the handler's hands were washed thoroughly and the genital area was allowed to air dry. The urine sample collection bag was then attached firmly after adhesive removal. Cosmetics which interfered with the adhesive's ability to stick were avoided. The narrow bridge on the adhesive patch prevented feces from contaminating the urine sample and helped in proper positioning of collection bag.

In females, adhesive application was started at the narrow bridge of skin separating the vagina and the anus and the adhesive was then firmly pressed against the skin, securing the adhesive.

In males, the prepucial area was cleaned thoroughly prior to collection.

Adhesive application was started at the narrow bridge of skin between the anus and the scrotum and then, firmly secured.

Figure3: Urine collecting bag

MIDSTREAM CLEAN CATCH:

The patient's genitalia was cleaned thoroughly from front backwards. He/she was then asked to void the urine into the sterile container after passing the initial and final void of the urinary stream into the toilet.

CATHETERIZED SAMPLE:

Patient is made to lie on his/her back. After selecting a catheter appropriate for the patient, the area is painted and prepared under aseptic precautions.

Male catheterization: The foreskin is retracted using a sterile gauze in the non dominant hand. Once the meatus is visible, the glans is cleaned using a sterile swab. Anesthetic gel is instilled into the urethra. The catheter is advanced till it enter the bladder. The urine drained is collected in sterile container.

Female catheterization: The urethral meatus is cleaned after separating the labia. An appropriate catheter coated with anesthetic gel is advanced till

urine is drained and collected in sterile container. Following the procedure, the catheter is removed and discarded.

Details of the patient were labelled over the container following collection and send for urine analysis and urine culture.Urine sample collected was send within 2 hours of collection since urine sample beyond 4 hours is unreliable for true interpretation.Urine analysis was performed by dipstick tests and direct microscopy. Dipstick using Multistixtest(Bayer corporation) , microscopic analysis and culture on the urine specimen was done.

DIPSTICK METHOD:

Multistix dipsticks were stored in tightly sealed containers at a temperature of 15-30 deg C. Since results could be altered on exposure to heat and light, appropriate storage of the dipsticks were strictly enforced. The quantimetric dropper was stable at room temperature and could be used till 1 month.

Procedure of dipstick:

A test dipstick strip is removed from the bottle of urine dipsticks. The bottle is tightly sealed before proceeding further. The urine container is gently swirled for adequate mixing of the urine. The pads on the dipstick is immersed in the urine sample and removed immediately. While removing the strip from the container, the edge of the dipstick is wiped on the rim of the container to remove excess urine. The dipstick is held away to avoid mixing reagents from

adjacent pads. The dipstick is then held near the colour chart on the bottle of dipsticks and is read in order in the given time interval as per the interpretation chart. The glucose pad is nearest the hand held end of the dipstick. Colour changes that occur beyond the reading time are more error prone. Record the results along with the date, time and other details.

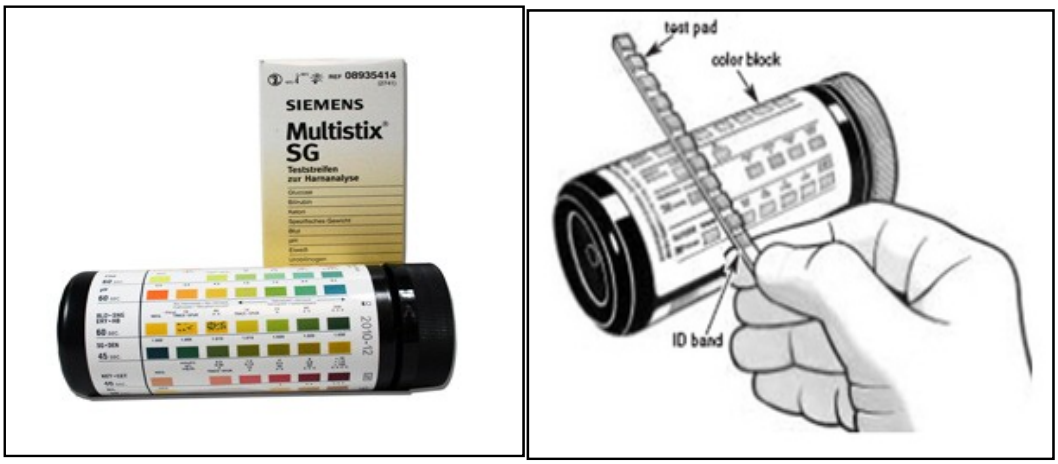
Table 7: Time of interpretation for dipstick tests

Parameter	Read at	Interpreted as
Leukocyte Esterase	2min	Negative,Trace, 1+, 2+, 3+
Nitrites	60 sec	Positive or Negative
Albumin	60 sec	Negative, Trace, 1+, 2+, 3+,4+

Principle of the dipstick procedure:

Multistix reagents are clear plastic strips which contain 7 different reagents fixed on the strip. The different cellulose areas are impregnated with different and specific chemicals according to the test which reacts with specific constituents of the urine by producing colour change. Colour change chart is referred for presence of abnormal substances.

Figure4: Multistix dipstick test



Nitrites:

This test is dependent on conversion of nitrites to nitrates in the presence of Gram negative organism.The nitrite area of the Multistix dipstick is impregnated with p-arsenilic acid, which reacts with nitrites to form a diazonium salt. This salt reacts with benzoquinolone to form a pink azo dye.

Leukocyte Esterase:

Leukocyte esterase is present in granulocytic leukocytes that hydrolyze pyrrole amino acid ester and liberates 3-hydroxy-5-phenyl pyrrole. This hydrolyzed pyrrole reacts with diazonium salt to produce a purple coloured compound which is detected by the dipstick.

Albumin:

This test is based on the principles of protein error of pH indicators. Proteins carry a charge at physiological pH. When the pH is constant, there is a colorchange to green color due to the presence of protein.The reagent impregnated is tetrabromophenol blue buffered to an acid pH of 3 or

tetrabromophenol- tetrabromosulphopthalein. Yellow color refers to absence of protein. Yellow-green, green, green-blue colors are all indicative of different ranges of proteins in the urine.

MICROSCOPY:

After testing the sample with Multistix dipstick test, the urine sample is placed in a plastic conical tube which is labelled.The tube is covered with a tight fitting cover. The tube is placed in centrifuge along a second tube filled with water in equal amounts which acts as counter weight. Urine specimen is then centrifuged at relative centrifugal force of 400xg for 5-10min. After centrifuge has stopped, remove tube and pour off the supernatant, leaving sediment in the bottom of the tube. With a plastic pipette mix the remaining liquid and sediment. In cases where no sediments are visible, remove a few drops of the mixture from bottom of the tube.Place a drop of the sediment solution over a glass slide and place a cover slip.

Examine the sediment using phase contrast or light under low10X and high power 40X power, scanning several fields to obtain an estimate on the average number of elements

Principle:

The urine microscopy is a method of identifying and quantifying bacteria,cells and other materials in a sediment of centrifuged sample. This allows for adequate identification of cellular elements in the urine sample and

aids the practitioner in ruling out practitioner in ruling out a renal or urinary tract disease.

The elements maybe organized or unorganized elements. Organized elements refer to RBCs, WBCs, Epithelial cells, Hyaline, cellular, granular, fatty casts. Bacteria may also be visible under direct microscopy. Microscopic hematuria, wbcs and bacteria are analysed in this study.

INTERPRETATION AND STANDARDS USED:

Pyuria: Since the sample was centrifuged, a lab cut off of >5cells/ hpf was considered positive.

Hematuria: >5red blood cells/hpf was considered positive.

Albumin was interpreted as trace, 1+, 2+, 3+ and 4+. Result >or = 1+ was considered positive.

Table 8: Interpretation of Albumin

Albumin	Interpretation
Trace	10-20mg/dl
1+	30mg/dl
2+	100mg/dl
3+	300mg/dl
4+	1-2g/dl

Nitrites was reported as positive or negative based on presence or absence.

Leukocyte esterase was interpreted as negative, trace,1+,2+ and 3. Any result.>or=1+ was considered positive.

Table 9: Interpretation of Leukocyte esterase

Leukocyte esterase	Interpretation
Trace	<10cells/cu.mm
1+	25cells/cu.mm
2+	100
3+	500

Bacteria was interpreted as Nil,1+,2+,3+ and 4+.Result >or = 1+ was considered positive.

Table 10: Interpretation of bacteriuria

Bacteriuria	Interpretation
1+	1-10 bacteria/hpf
2+	11-100 bacteria/hpf
3+	>100 bacteria/hpf
4+	Field packed with organisms

Urine culture:

Principle:

Urine cultures are performed to detect the organism responsible for causing urinary tract infection. Normally the urinary tract is sterile above the level of urethra. However there is high risk of contamination with conventional method of urine collection especially non invasive methods like bag method. Hence cultures utilize a quantitative cut off or significant colony forming units

to help differentiate between contamination, infection or colonization. However low counts maybe significant if patient is symptomatic.

Significant bacteriuria:

Urethral catherization> or equal to $5x10^4$CFU/ml

Midstream clean catch or bag method >or equal to 10^5CFU/ml

Significant bacteriuria of a single pathogen was considered as a positive culture.

Procedure:

The urine sample was inoculated onto blood and Mac Conkey agar plates.

All plates were incubated at 35-37 deg C for 24 hours under aerobic conditions to obtain accurate colony counts.Urine culture with a colony count of $10^5$of a single species was considered as significant.Samples which showed mixed growth or insignificant colony counts were excluded.

The results of urine analysis and urine culture were compared and the sensitivity, specificity, positive predictive value and negative predictive values were calculated in both the culture positive group and the sterile group.

STATISTICAL TOOL USED

The data collected from the patients were formatted into Microsoft Excel sheets to generate mastercharts, Tables and graphs. Diagramatic representation were used to depict significant clinical data from patients with culture proven

UTI.The Sensitivity,specificity,Negative predictive value and positive predictive values were calculated using the standard formulas.

Sensitivity= True positive/(true positive + false negative)

Specificity=True negative/(True negative + False positive)

Positive predictive value=True positive/ (true positive + False positive)

Negative predictive value=True negative/ (true negative + false negative)

SPSS software was used to analyse data. Correlation of parameters with age were assessed using chi- square pearson co-efficient test.

RESULTS:

200 patients with suspected urinary tract infection were enrolled in the study. 100 patients with culture proven UTI and 100 patients with sterile urine cultures.

AGE AND SEX DISTRIBUTION OF CULTURE PROVEN UTI

Figure 4:

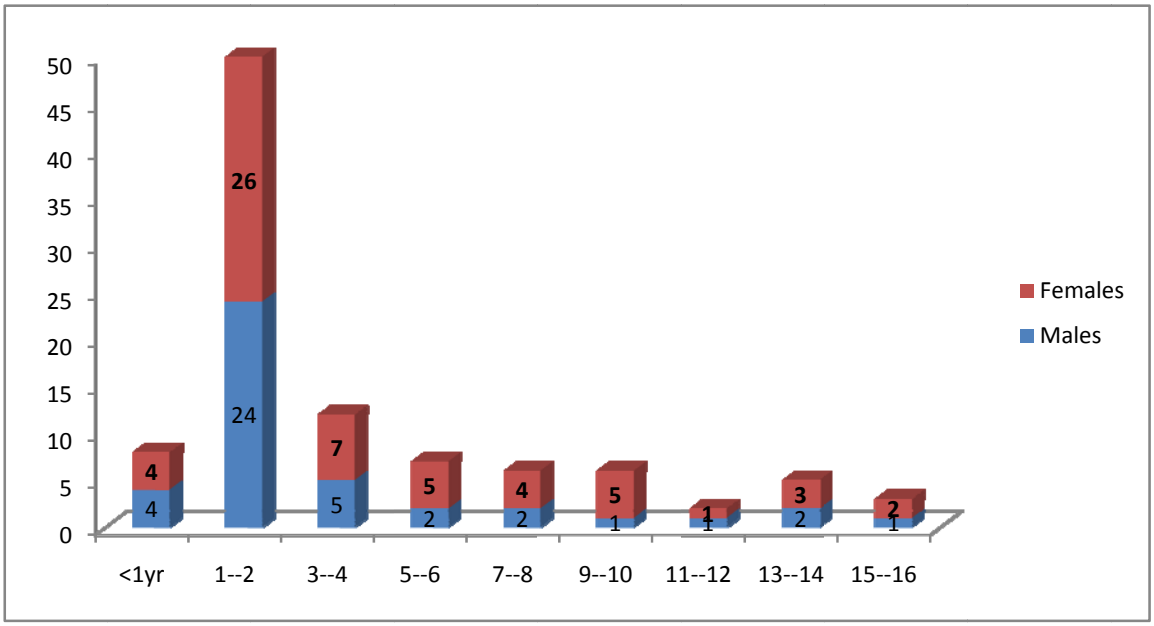


Table 11:

Age(in yrs)	Male	Female
<1	4	4
1-2	24	26
3-4	5	7
5-6	2	5
7-8	2	4
9-10	1	5
11-12	1	1
13-14	2	3
15-16	1	2

AGE AND SEX DISTRIBUTION OF STERILE CULTURE GROUP

Figure 5:

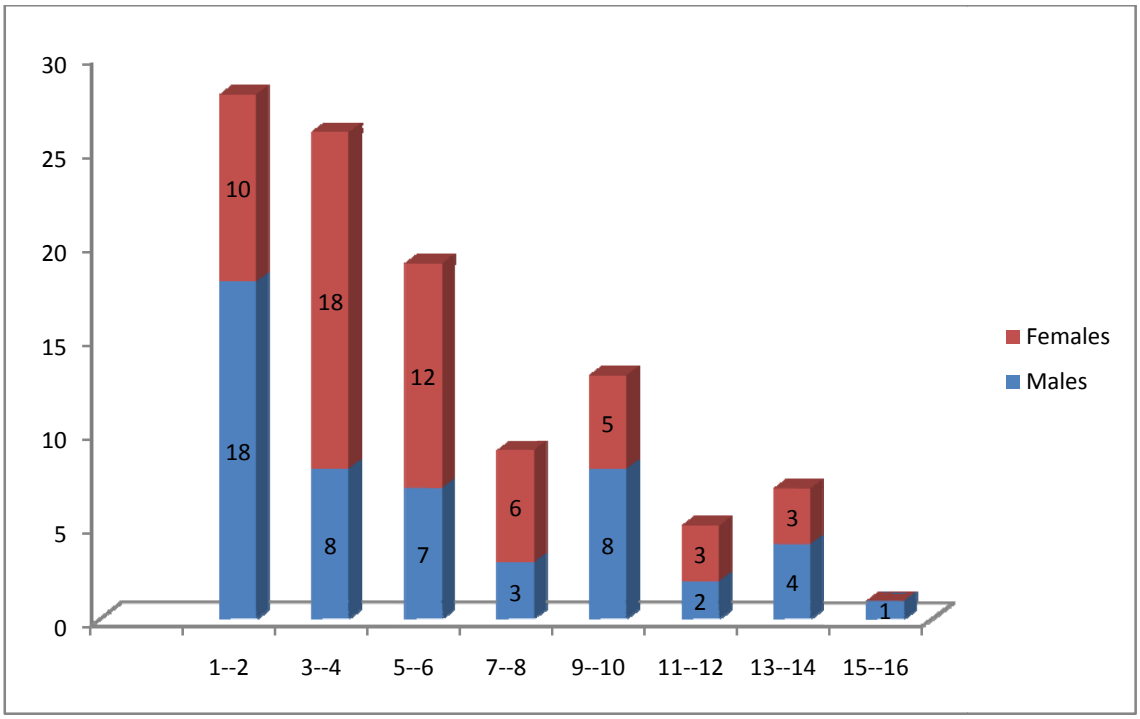


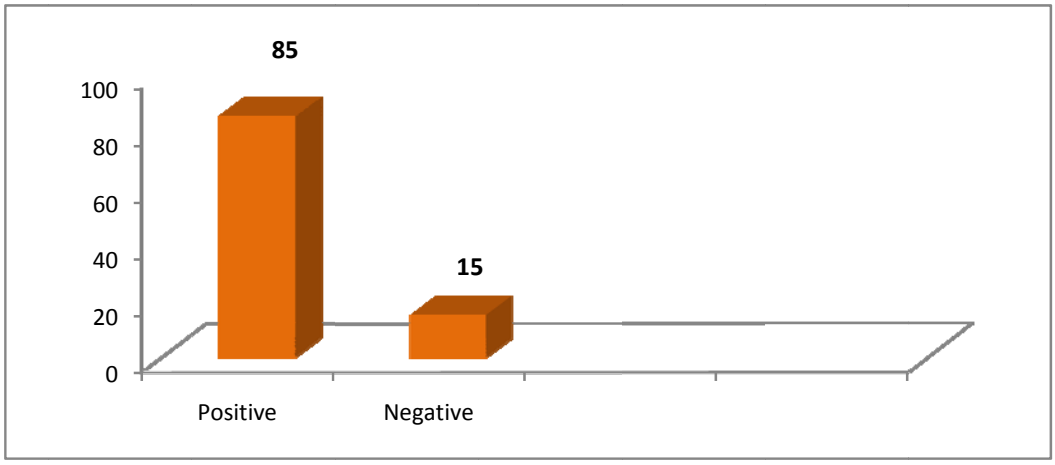
Table 12:

Age(in yrs)	Male	Female
<1	-	-
1-2	18	10
3-4	8	18
5-6	7	12
7-8	3	6
9-10	8	5
11-12	2	3
13-14	4	3
15-16	1	-

URINE ANALYSIS IN BOTH GROUPS:

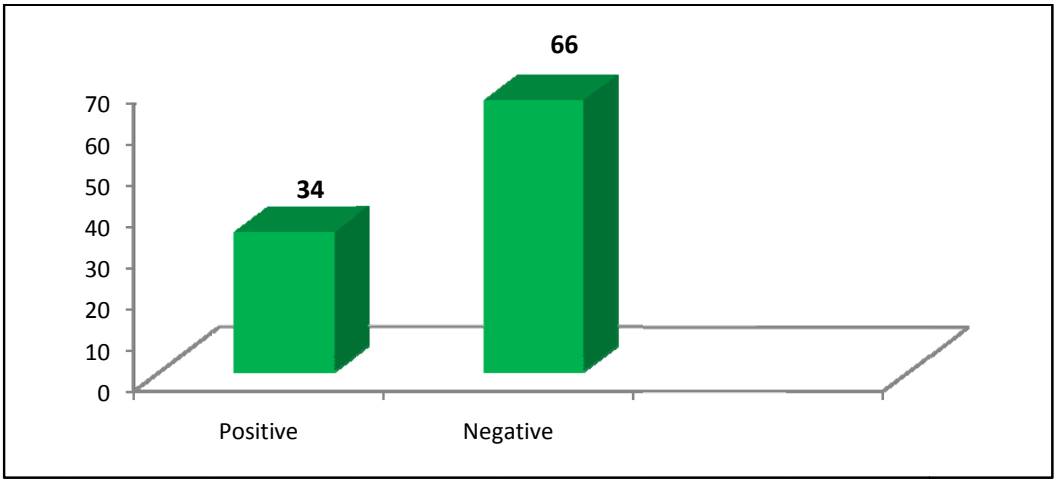
Among the culture proven UTI group, urine analysis was positive in 85 cases and negative in 15 cases.

Figure 6:



Urine analysis was positive in 33 cases and negative in 64 cases in the sterile culture group.

Figure7:



SENSITIVITY, SPECIFICITY, NEGATIVE AND POSITIVE PREDICTIVE VALUE

Figure 8:

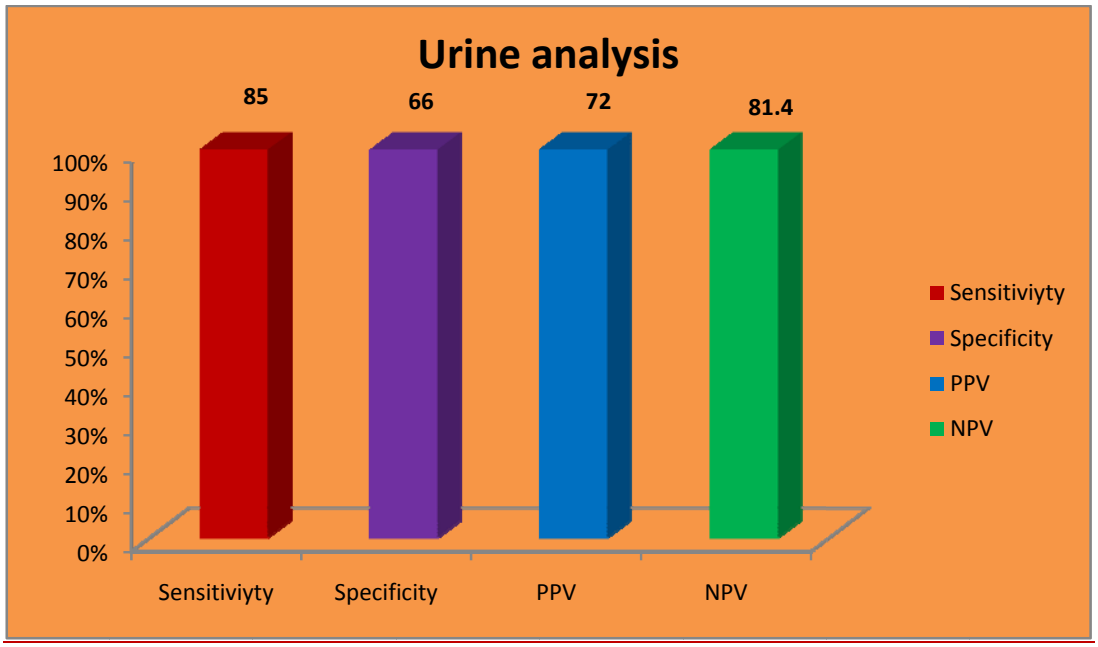


Table 13

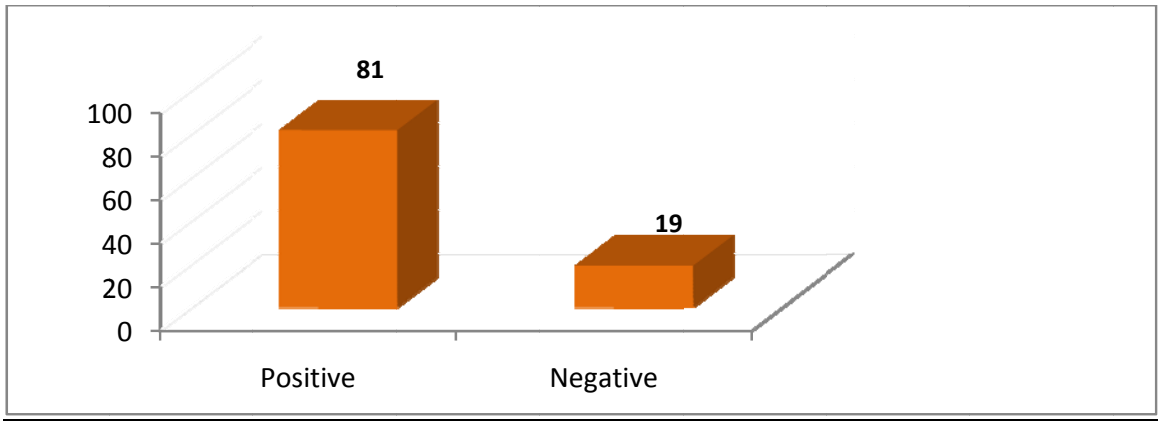
Urine Analysis	Culture proven UTI	Sterile culture	Total
Positive	85	34	
Negative	15	66	
Total	**100**	**100**	**200**

INDIVIDUAL PARAMETERS IN EACH GROUP:

1. LEUKOCYTE ESTERASE

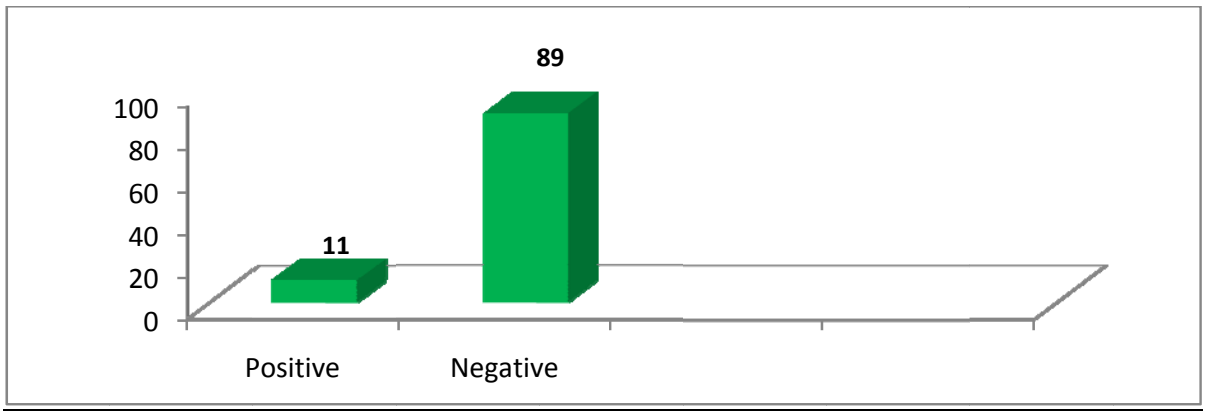
In the culture proven UTI, Leukocyte esterase was positive in 81 cases and negative in 19 cases.

Figure 9:



Leukocyte esterase was positive in 11 cases and negative in 89 cases in sterile culture group.

Figure10:



CHI-SQUARE TEST VALUE=101.64, D.F. =1, P<0.001

The significant p-value confirms that the presence of Leukocyte Esterase was higher in the culture positive group as compared to the sterile culture group.

QUANTIFICATION OF LEUKOCYTE ESTERASE IN CULTURE POSITIVE GROUP

Among the culture proven UTI, leucocyte esterase was positive in 81 cases. Out of 81, Leucocyte 1+ was positive in 21 cases, leucocyte esterase 2+ was positive in 28 cases and leucocyte esterase 3+ was positive in 32 cases.

Figure11:

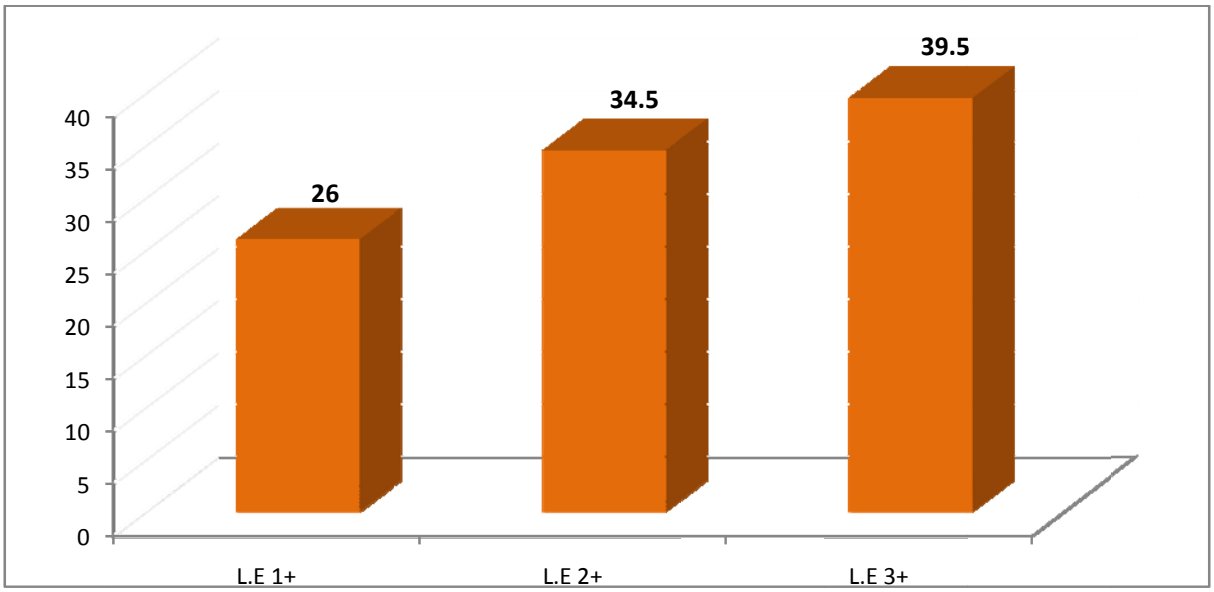


Table 14:

Leucocyte Esterase	Frequency(n=81)	Percentage
L.E1+	21	26
L.E2+	28	34.5
L.E3+	32	39.5

QUANTIFICATIONOF LEUKOCYTE ESTERASE IN STERILE GROUP

In the sterile group, Leukocyte esterase was positive in 10 cases, out of which majority was leukocyte 2+, followed by leukocyte 1+.

Figure12:

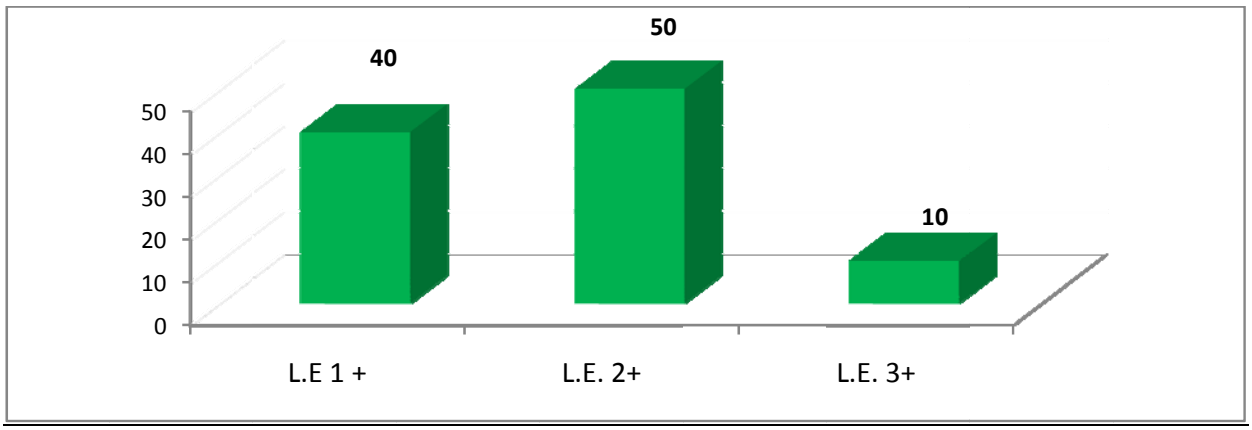


Table15:

Leukocyte Esterase	Frequency	Percentage
L.E1+	4	40
L.E2+	5	50
L.E3+	1	10

SENSITIVITY, SPECIFICITY, NEGATIVE PREDICTIVE VALUE AND POSITIVE PREDICTIVE VALUE

Figure13:

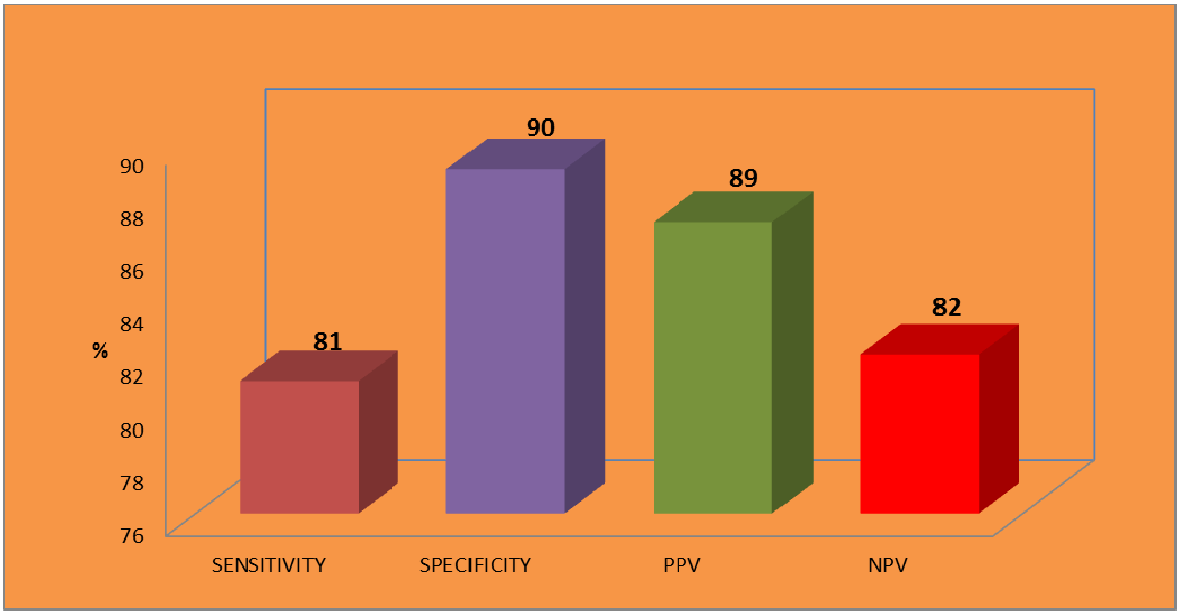


Table16:

	Culture		Total
Leukocyte Esterase	**Positive**	**Negative**	
Positive	81	10	
Negative	19	90	
Total	**100**	**100**	**200**

Sensitivity = 81/(81+19) = 81%

Specificity = 90/(90+10) = 90%

Positive Predictive value = 81/(81+10) = 89%

Negative Predictive value = 89/(90+19) = 82%

CORRELATION OF LEUKOCYTE ESTERASE WITH AGE IN THE CULTURE PROVEN GROUP

Table 17:

	Frequency	Percentage
<or = 1yrs	26	81.2%
2-4yrs	32	82.1%
5-9yrs	12	75%
>10yrs	11	84.6%

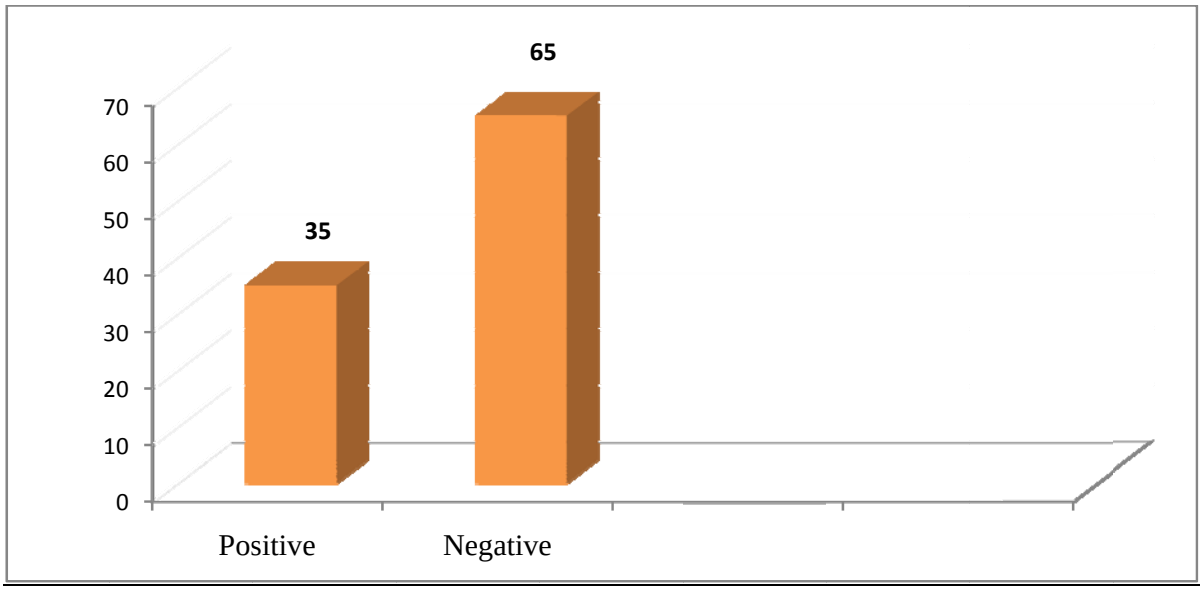
	Frequency	Percentage
<or = 1yrs	6	18.8%
2-4yrs	7	17.9%
5-9yrs	4	25%
>10yrs	2	15.4%

Chi square value=0.514

2. NITRITES

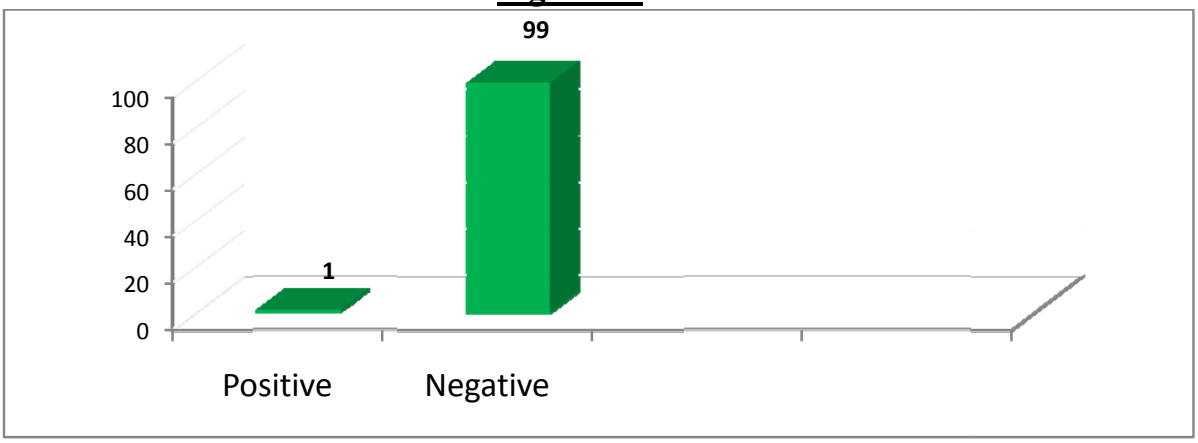
Among the culture proven UTI cases, nitrites were positive in 35 cases and negative in 65 cases

Figure 14:



Among the sterile cultures, nitrites were positive in 1 case and negative in 99 cases.

Figure15:



Chi square test value=39.16, d.f=1, P<0.001

The significant p-value infers that presence of nitrites has been higher among urine culture positive children compared to urine culture negative children.

SENSITIVITY, SPECIFICITY, NEGATIVE PREDICTIVE VALUE AND POSITIVE PREDICTIVE VALUE

Figure16:

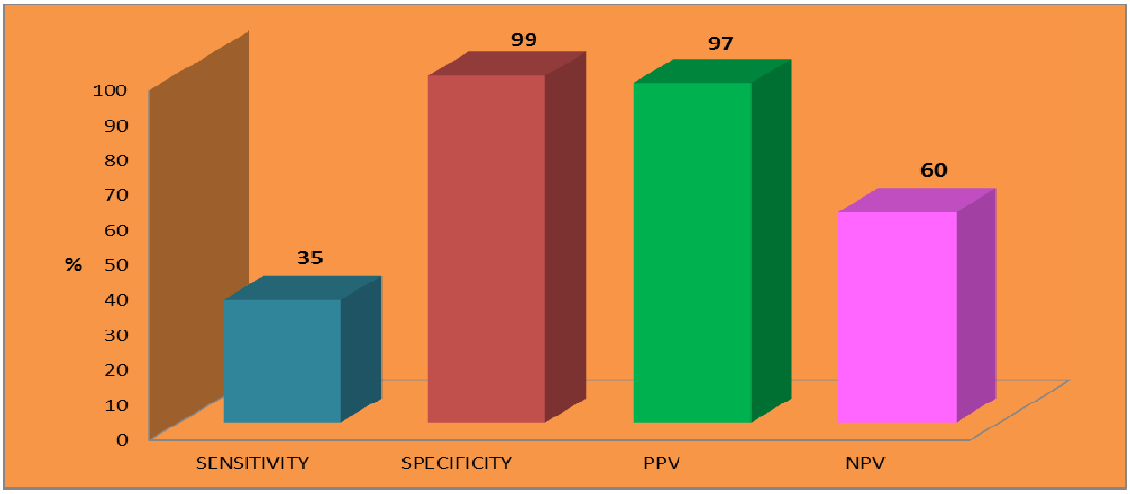


Table18:

	Culture		Total
Nitrites	**Positive**	**Negative**	
Positive	35	1	
Negative	65	99	
Total	**100**	**100**	**200**

Sensitivity= 35/(35+65) = 35%

Specificity = 99(99+1) = 99%

Positive Predictive value = 35/(35+1) =97%

Negative Predictive value = 65/(65+99)=60%

CORRELATION OF NITRITES WITH AGE

	Frequency	Percentage
<or = 1yrs	5	15.6%
2-4yrs	17	43.6%
5-9yrs	6	37.5%
>10yrs	7	53.8%

	Frequency	Percentage
<or = 1yrs	27	84.4%
2-4yrs	22	56.4%
5-9yrs	10	62.5%
>10yrs	6	46.2%

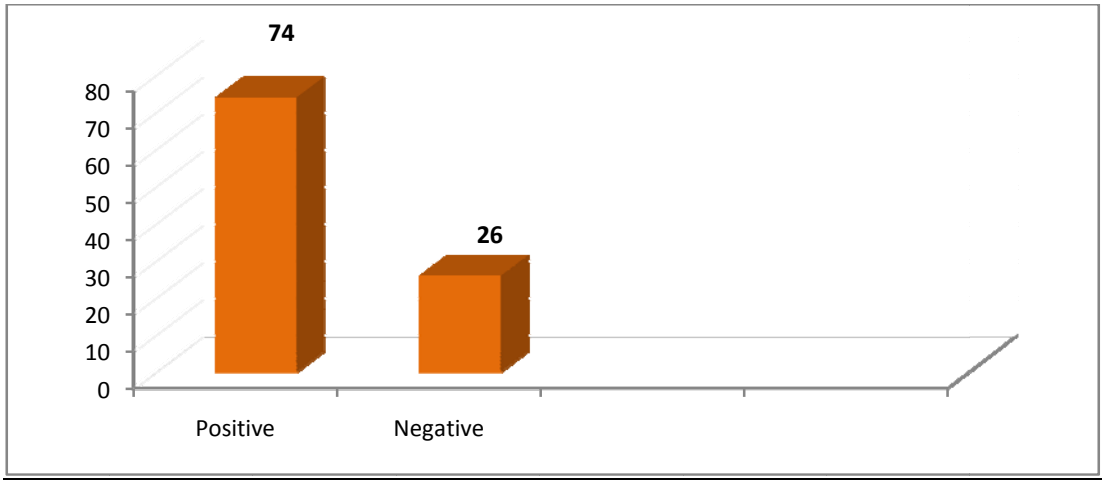
Chi-square test p value= 0.035, Chi square trend value p value=0.016

Chi square test was applied to look for correlation of nitrites with age. Further chi square trend was applied to see if nitrites positivity increased with age. The results showed a significant correlation with age and as age increases, there was a trend towards increasing nitrites positivity.

3. PYURIA

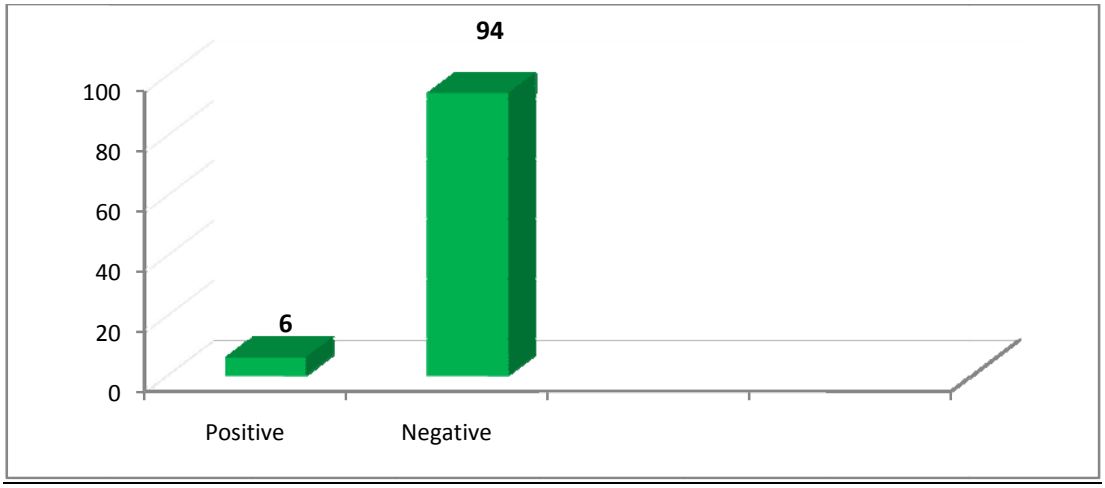
Among the culture prove UTI cases, pyuria was positive in 74 cases and negative in 26 cases.

Figure17:



Among the sterile culture group, pyuria was positive in 6 and negative in 94 cases.

Figure 18:



Chi-square test value=96.33, d.f.=1, P<0.001

Chi square test was applied to look at pyuria in both culture positive and sterile culture groups. P value suggests that pyuria was significantly higher in the culture positive group when compared to the sterile group.

QUANTIFICATION OF PYURIA IN CULTURE POSITIVE UTI GROUP

Figure19:

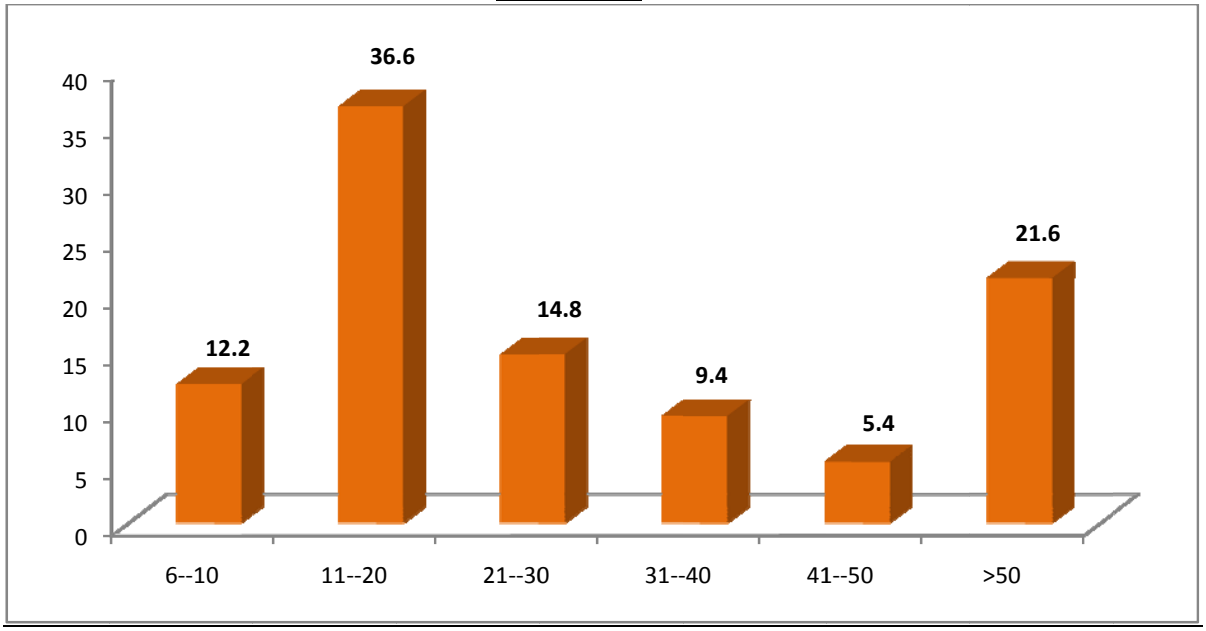


Table19:

Pus cells	Frequency	Percentage
0-10	9	12.2
11-20	27	36.6
21-30	11	14.8
31-40	7	9.4
41-50	4	5.4
>50	16	21.6

QUANTITATIVE REPRESENTATION OF PYURIA IN STERILE GROUP

Figure20:

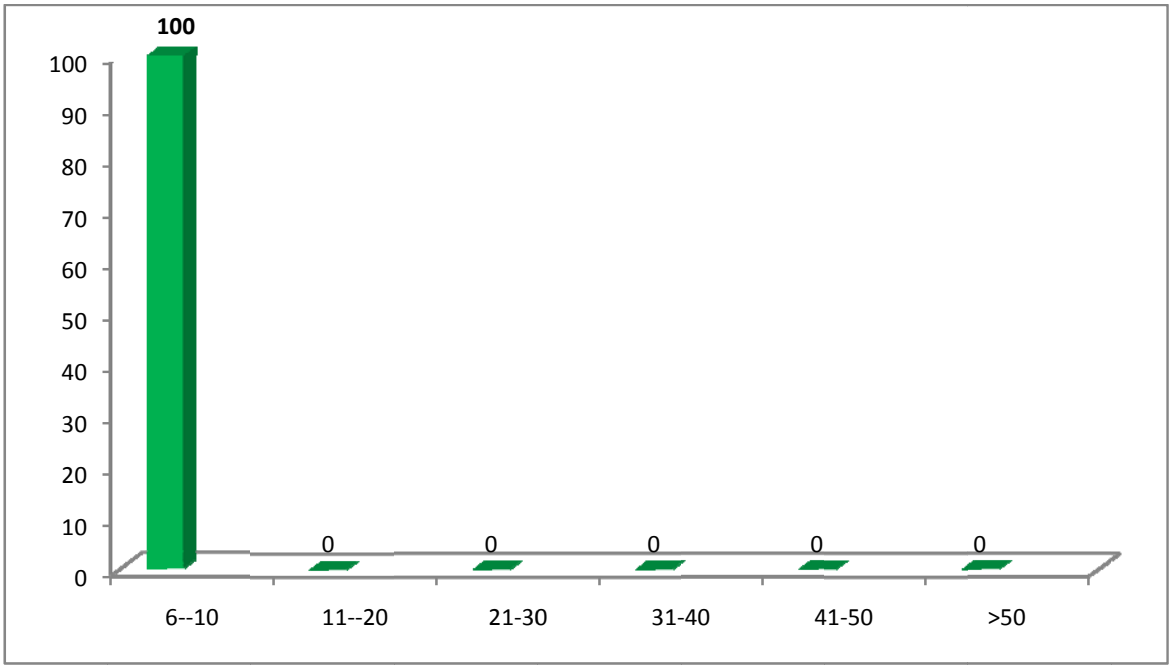


Table20:

Pus cells	Frequency	Percentage
6-10	6	100
11-20	0	0
21-30	0	0
31-40	0	0
41-50	0	0
>50	0	0

SENSITIVITY, SPECIFICITY, NEGATIVE AND POSITIVE PREDICTIVE VALUE

Figure21:

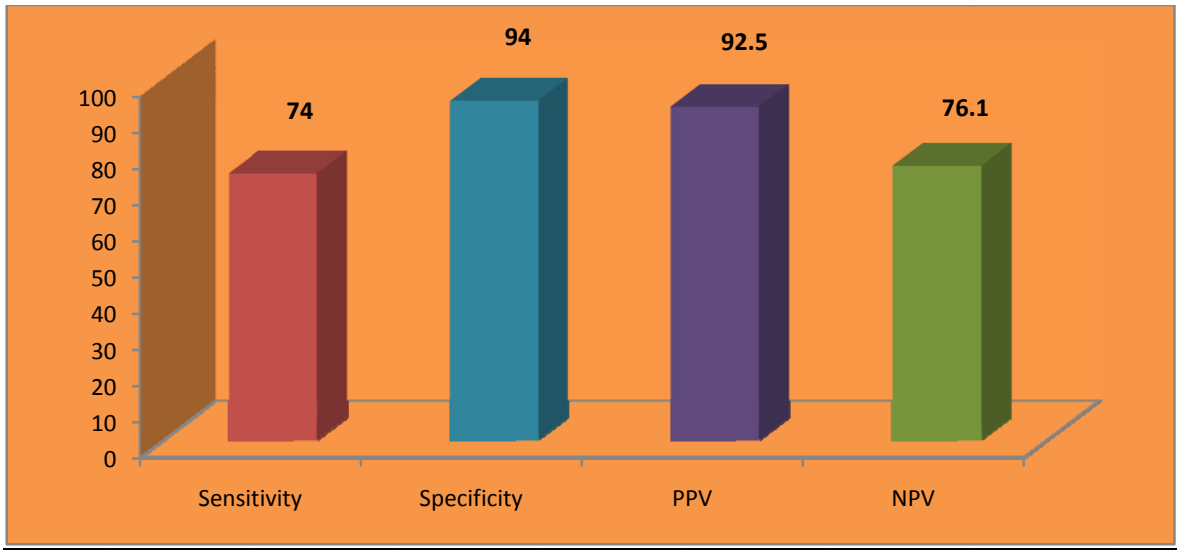


Table21:

	Culture		Total
Pyuria	**Positive**	**Negative**	
Positive	74	6	
Negative	26	94	
Total	**100**	**100**	**200**

Sensitivity = 74/(26+74) = 74%

Specificity = 94(94+6) = 94%

Positive Predictive value = 74/(74+6) = 92.5%

Negative Predictive value = 96/(96+26) = 76.1%

CORRELATION OF PYURIA WITH AGE IN THE CULTURE PROVEN UTI

Table22:

	Frequency	Percentage
<or = 1yrs	24	75%
2-4yrs	28	71.8%
5-9yrs	12	75%
>10yrs	10	76.9%

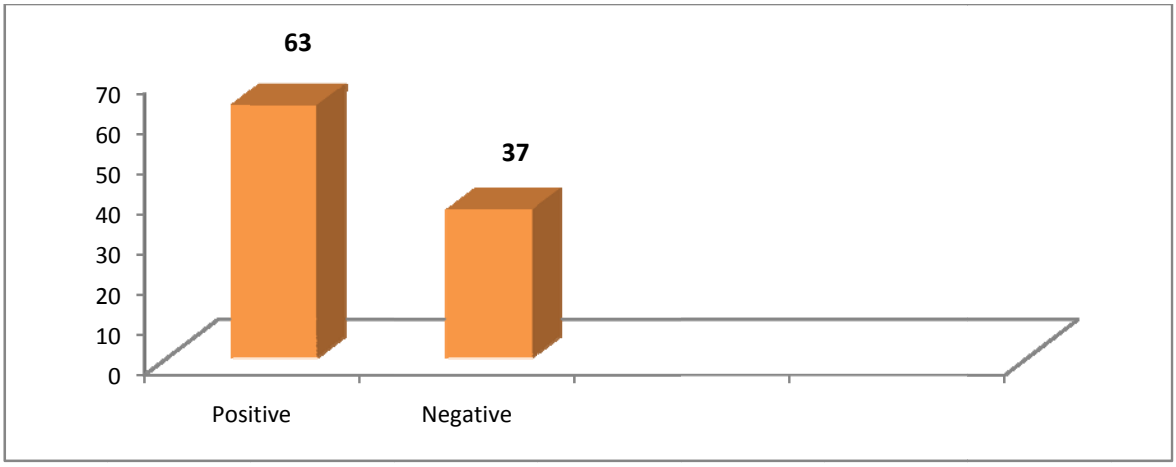
	Frequency	Percentage
<or = 1yrs	8	25%
2-4yrs	11	28.2%
5-9yrs	4	25.0%
>10yrs	3	23.1%

Chi square test value=0.181

4. BACTERIURIA

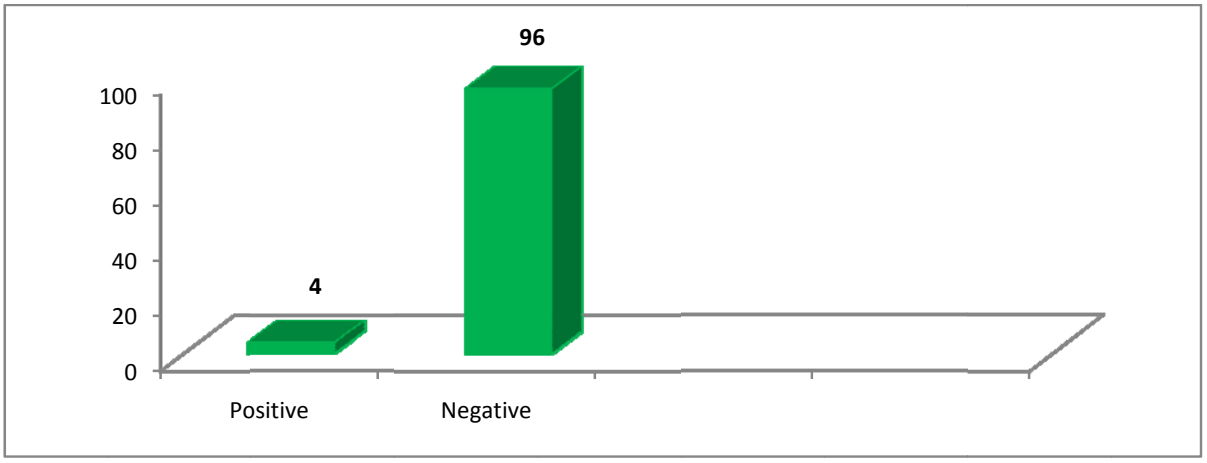
Among the culture proven UTI cases, bacteriuria was present in 63 cases and absent in 37 cases.

Figure22:



Among the sterile culture group, Bacteriuria was present in 4 cases and absent in 96 cases.

Figure23:



Chi-square test value=78.12, d.f.=1, P<0.001

Chi square analysis was done which showed that the bacteriuria in the culture positive group was significantly higher than the culture negative group.

QUANTITATIVE REPRESENTATION OF BACTERIURIA IN CULTURE POSITIVE UTI GROUP

Figure24:

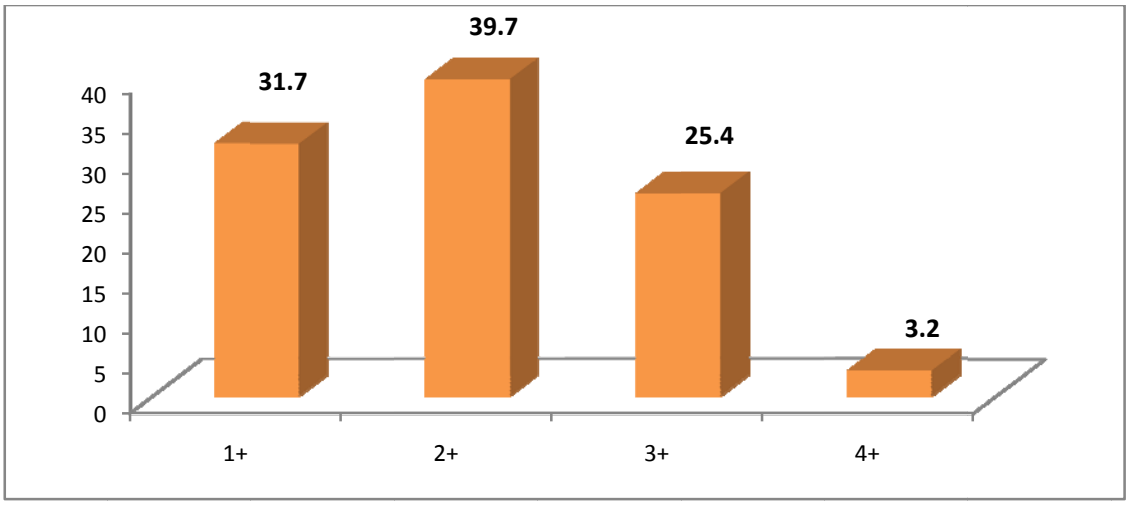


Table23:

Bacteriuria	Frequency	Percentage
1+	20	31.7
2+	25	39.7
3+	16	25.4
4+	2	3.2

QUANTITATIVE REPRESENTATION OF BACTERIURIA IN STERILE CULTURE GROUP

Figure25:

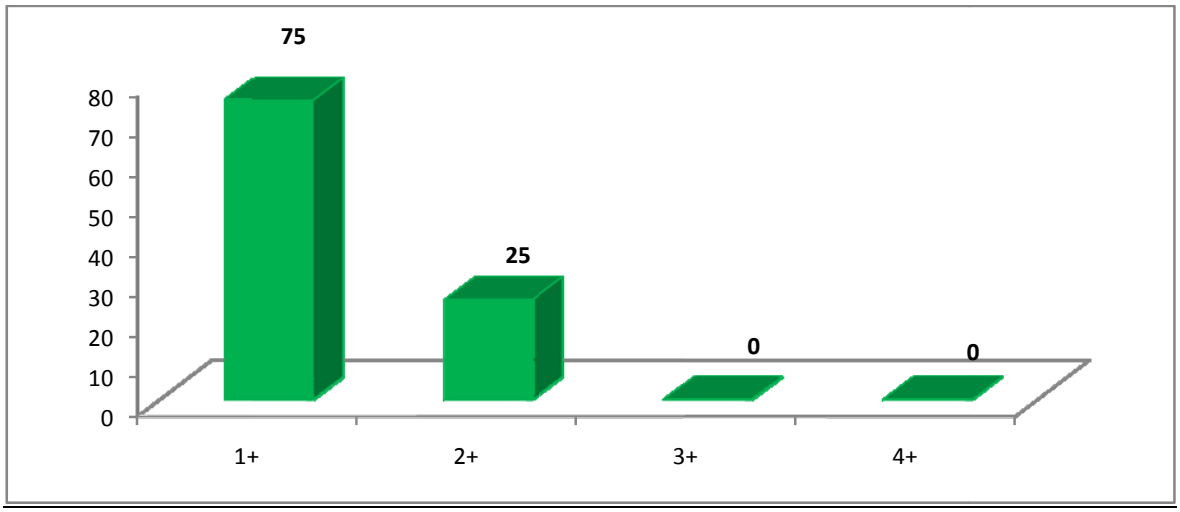


Table24:

Bacteriuria	Frequency	Percentage
1+	3	75
2+	1	25
3+	0	0
4+	0	0

SENSITIVITY, SPECIFICITY, NEGATIVE PREDICTIVE VALUE AND POSITIVE PREDICTIVE VALUE OF BACTERIURIA

Figure26:

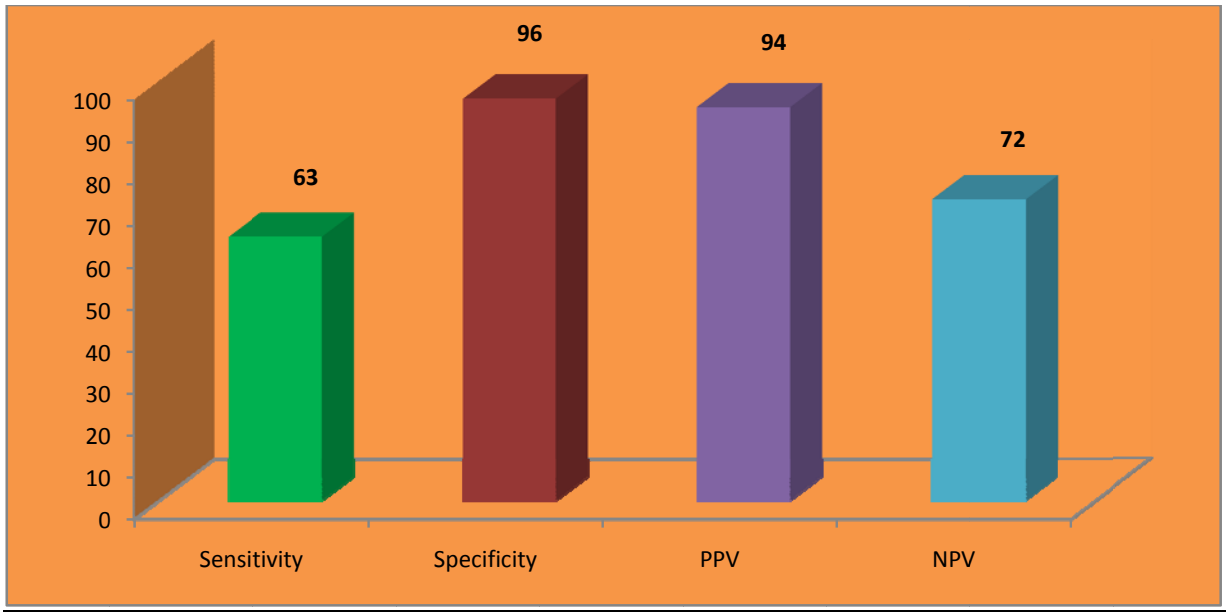


Table25:

	Culture		Total
Bacteriuria	**Positive**	**Negative**	
Positive	63	4	
Negative	37	96	
Total	**100**	**100**	**200**

Sensitivity =63 /(37+63) = 63%

Specificity = 96(96+4) = 96%

Positive Predictive value = 63/63+4) = 94%

Negative Predictive value = 96/(96+37) = 72%

CORRELATION OF BACTERIURIA WITH AGE

Table26:

	Frequency	Percentage
<or = 1yrs	20	62.5%
2-4yrs	26	66.7%
5-9yrs	10	62.5%
>10yrs	7	53.8%

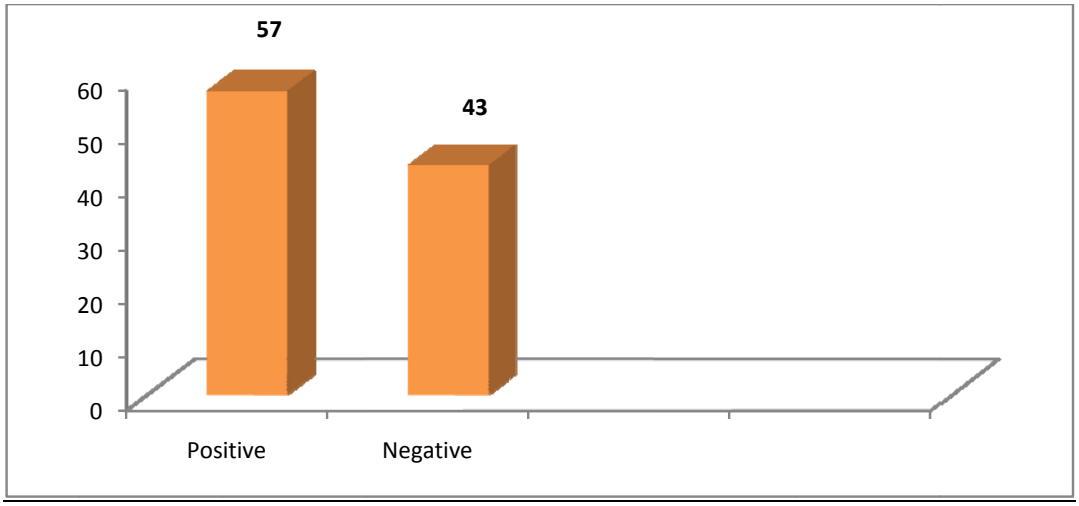
	Frequency	Percentage
<or = 1yrs	12	37.5%
2-4yrs	13	33.3%
5-9yrs	6	37.5%
>10yrs	6	46.2%

Chi square value=0.874

5. HEMATURIA

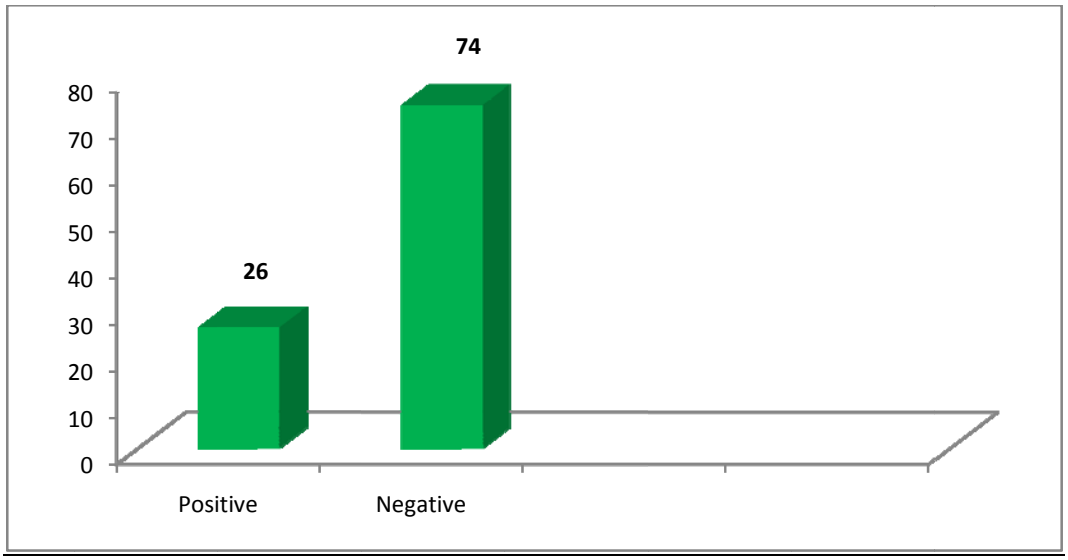
In the culture positive UTI cases, hematuria was present in 57 cases and absent in 43 cases.

Figure27:



In the sterile group, hematuria was positive in 26 cases and negative in 74 cases.

Figure28:



Chi-square test value=19.79,d.f.=1, P<0.001

Chi square analysis done showed significantly higher hematuria in culture positive UTI as compared to the sterile culture group.

QUANTIFICATION OF HEMATURIA IN CULTURE POSITIVE UTI

Figure29:

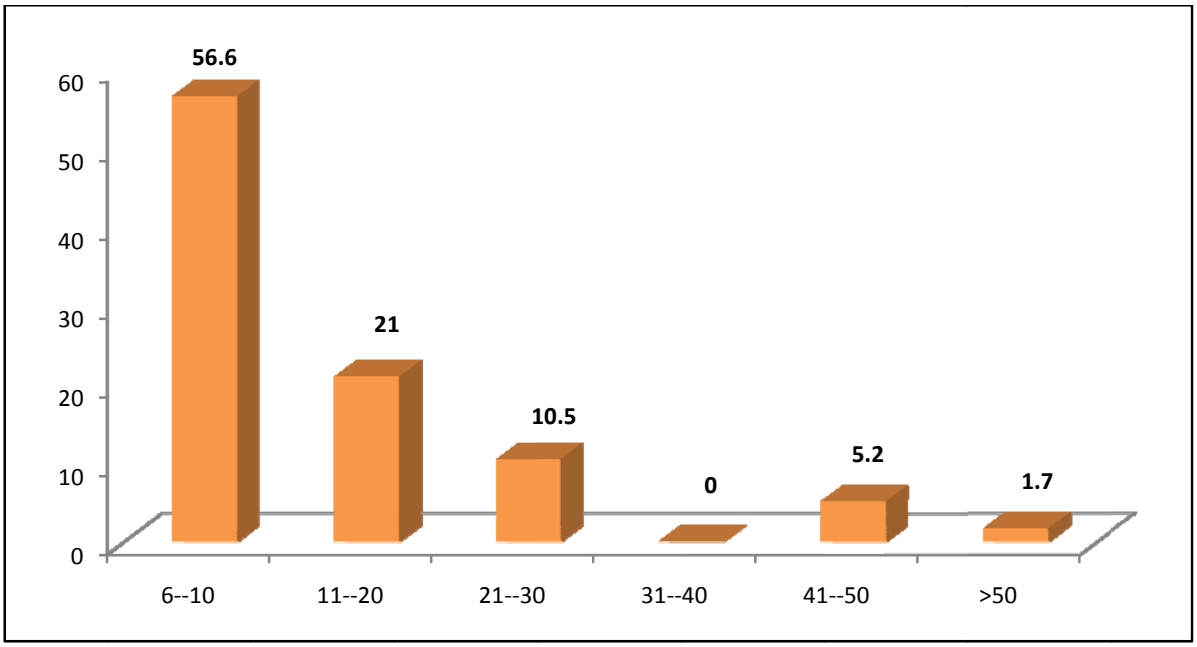


Table27:

Hematuria	Frequency	Percentage
6-10	35	56.6
11-20	12	21
21-30	6	10.5
31-40	0	0
41-50	3	5.2
>50	1	1.7

QUANTIFICATION OF HEMATURIA IN THE CULTURE STERILE GROUP

Figure30:

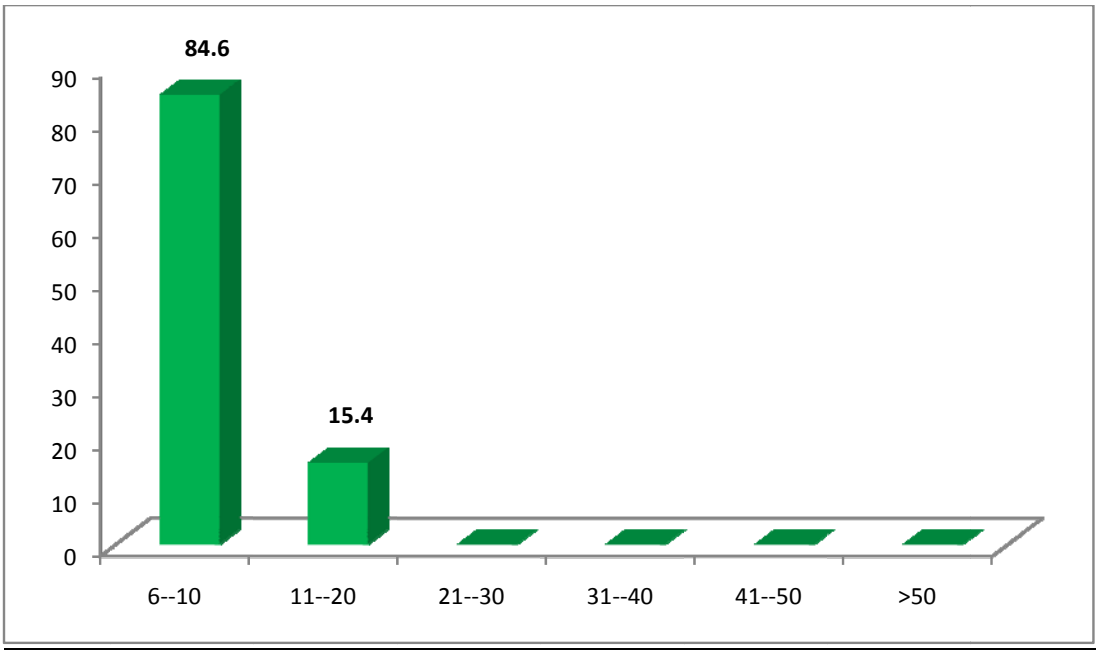


Table28:

Hematuria	Frequency	Percentage
6-10	22	84.6
11-20	4	15.4
21-30	0	0
31-40	0	0
41-50	0	0
>50	0	0

SENSITIVITY,SPECIFICITY,NEGATIVE PREDICTIVE VALUE AND POSITIVE PREDICTIVE VALUE OF HEMATURIA

Figure31

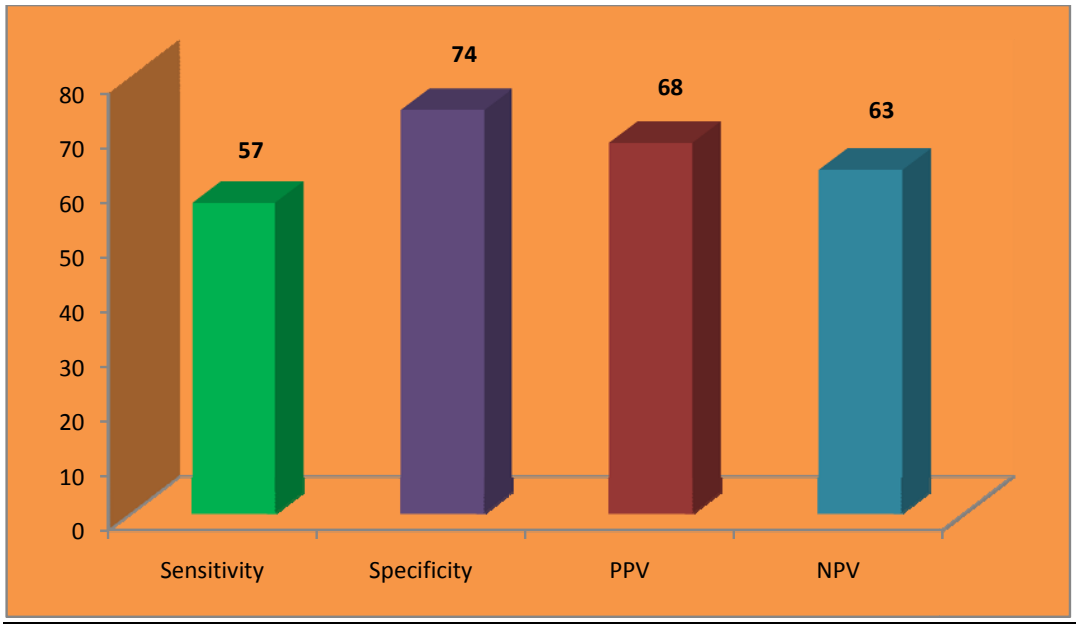


Table29:

	Culture		Total
Hematuria	**Positive**	**Negative**	
Positive	57	26	
Negative	43	74	
Total	**100**	**100**	**200**

Sensitivity =57/(57+43)= 57%

Specificity = 74/(74+26)=74%

Positive Predictive value =57/(57+26)= 68%

Negative Predictive value = 74(74+43)=63%

CORRELATION OF HEMATURIA WITH AGE

Table30:

	Frequency	Percentage
<or = 1yrs	19	59.4%
2-4yrs	17	43.6%
5-9yrs	12	75%
>10yrs	9	69.2%

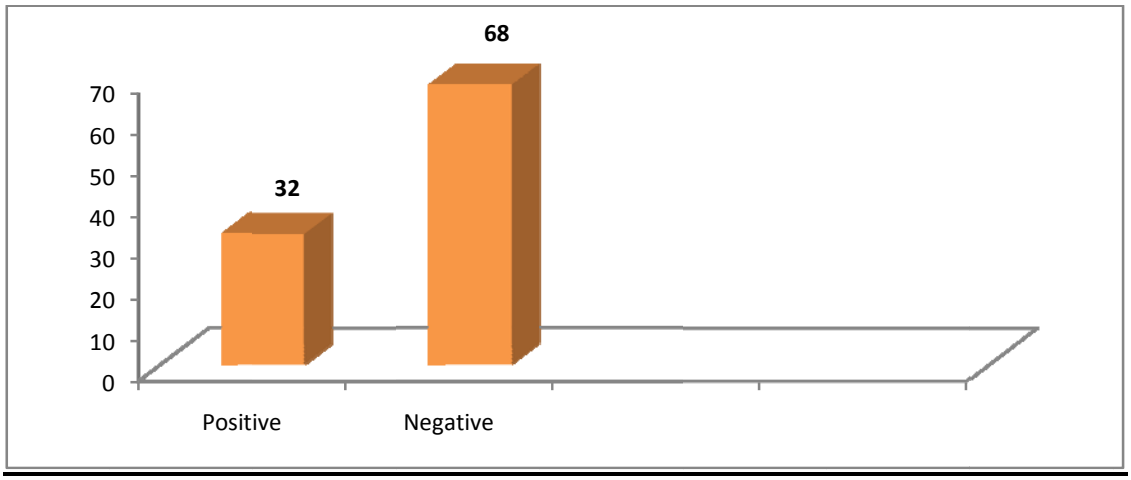
	Frequency	Percentage
<or = 1yrs	13	40.6%
2-4yrs	22	56.4%
5-9yrs	4	25%
>10yrs	4	30.8%

P value=0.119

ALBUMIN

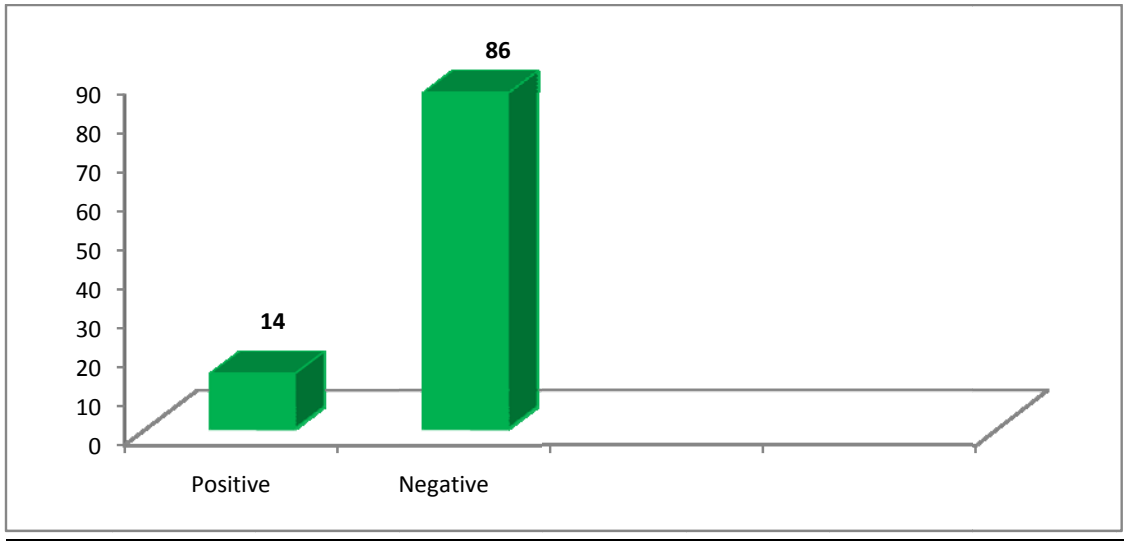
In culture positive UTI cases, albumin was positive in 32 cases and negative in 68 cases.

Figure32:



Albumin was positive in 14 cases and negative in 86 cases in sterile group

Figure33:



Chi square analysis showed that albuminuria was significantlty higher in the culture positive group as compared to the sterile group

SENSITIVITY,SPECIFICITY,POSITIVE AND NEGATIVE PREDICTIVE VALUE

Figure34:

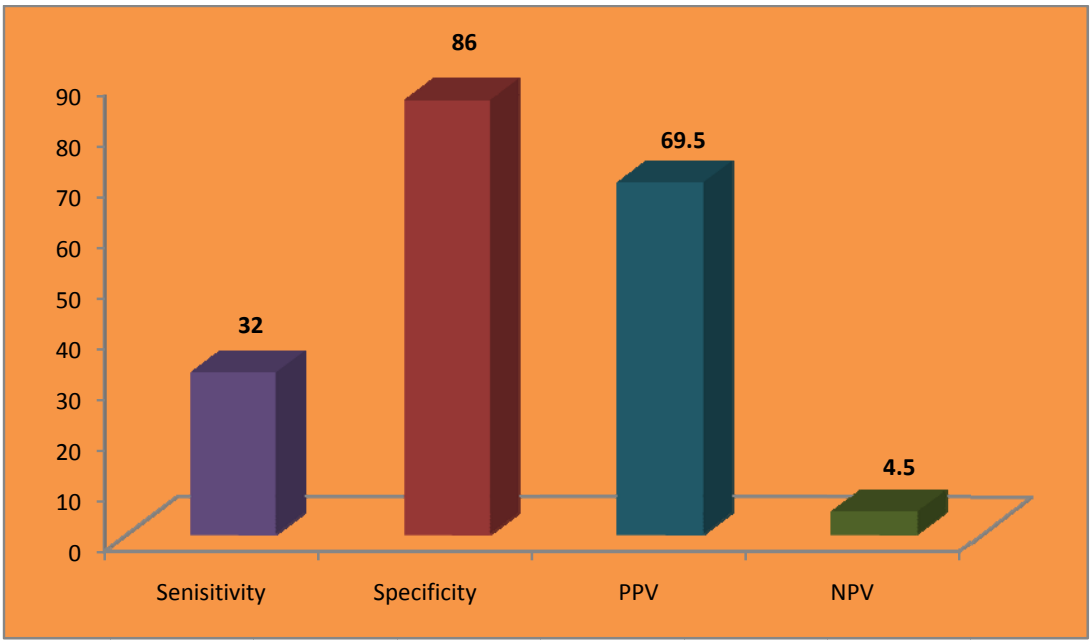


Table31:

	Culture		Total
Albumin	**Positive**	**Negative**	
Positive	32	14	
Negative	68	86	
Total	**100**	**100**	**200**

QUANTIFICATION OF ALBUMIN IN CULTURE PROVEN UTI

Figure35:

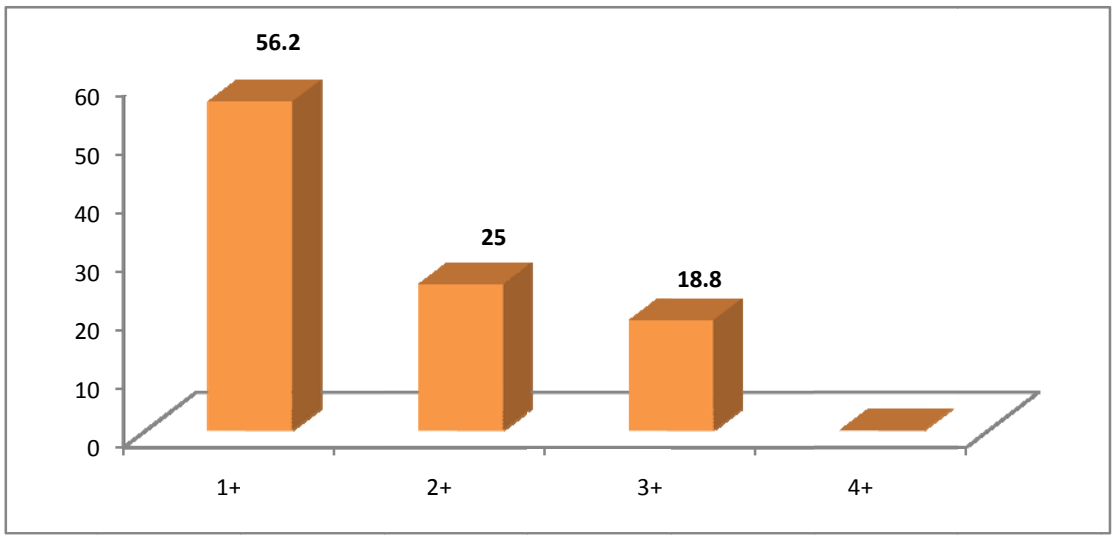


Table32:

Albumin	Frequency	Percentage
1+	18	56.2
2+	8	25
3+	6	18.8
4+	-	-

QUANTIFICATION OF ALBUMIN IN STERILE CULTURE GROUP

Figure36:

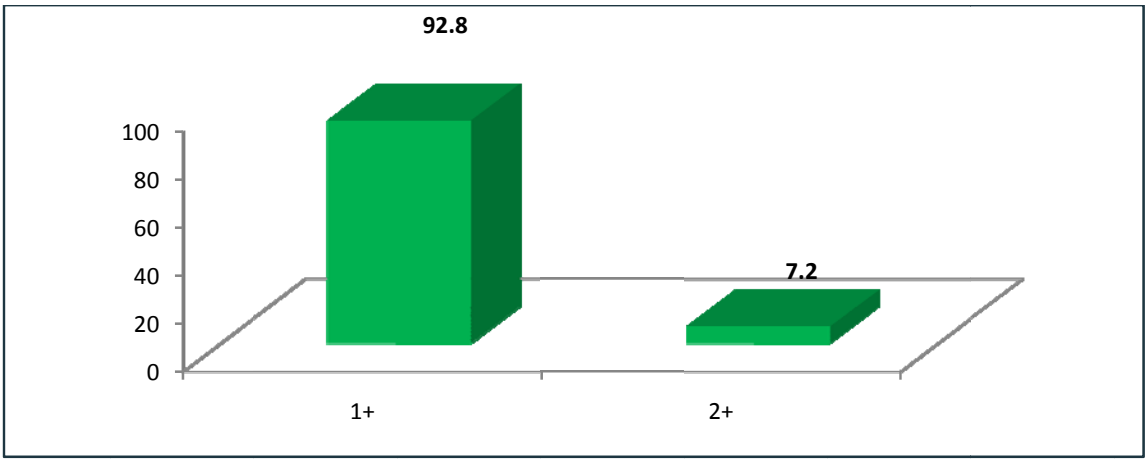


Table33:

Albumin	Frequency	Percentage
1+	13	92.8%
2+	1	7.2%
3+	0	0

CORRELATION WITH AGE

Table34

	Frequency	Percentage
<or = 1yrs	10	31.2%
2-4yrs	9	23.1%
5-9yrs	9	56.2%
>10yrs	4	30.8%

	Frequency	Percentage
<or = 1yrs	22	68.8%
2-4yrs	30	76.9%
5-9yrs	7	43.8%
>10yrs	9	69.2%

p=0.123

SENSITIVITY AND SPECIFICITY OF COMBINED PARAMETERS

Table35:

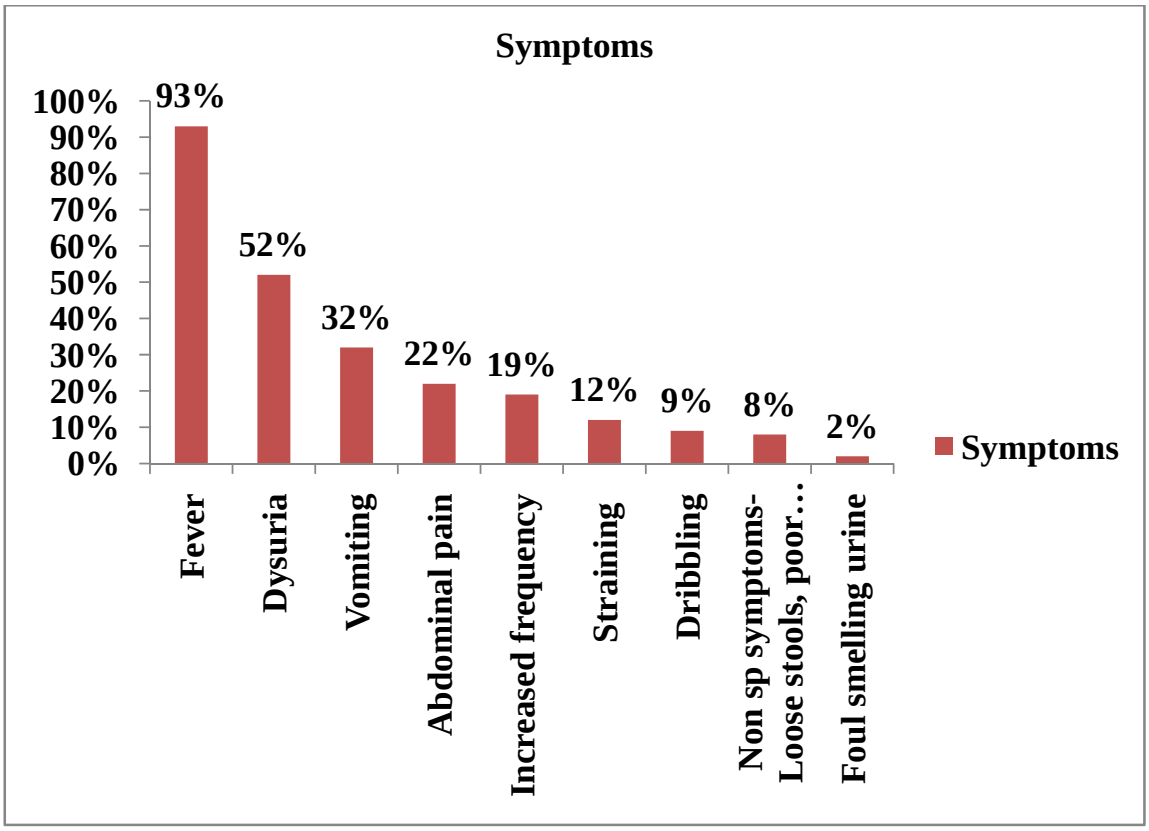
Parameter	Sensitivity	Specificity	PPV	NPV
L.E +/ Pyuria	81%	89%	88%	82.4%
L.E +/ Albumin	83%	78%	79%	82.1%
L.E +/ bacteriuria	82%	86%	85.4%	82.7%
Pyuria +/ hematuria	78%	70%	72.2%	76.1%
Pyuria +/ Albumin	77%	80%	79.4%	77.7%
Nitrites +/ hematuria	68%	74%	72.3%	69.8%
Nitrites+/ albumin	55%	85%	78.6%	65.4%
Hematuria+/ bacteriuria	82%	74%	75.9%	80.4%
Albumin +/ bacteriuria	73%	84%	82%	75.7%
Hematuria+/ Albumin	59%	70%	66.3%	63.1%

Table36:

Parameter	Sensitivity	Specificity	PPV	NPV
L.E +/ Hematuria	83%	70%	73.5%	80.5%
L.E +/ Nitrites	82%	90%	89.1	83.3
Pyuria +/ bacteriuria	81%	90%	89%	82.6%
Pyuria +/ Nitrites	80%	93%	92%	82.3%
Nitrites +/ bacteriuria	67%	95%	93.1%	74.2%

CLINICAL FEATURES OF THE CULTURE PROVEN UTI CASES

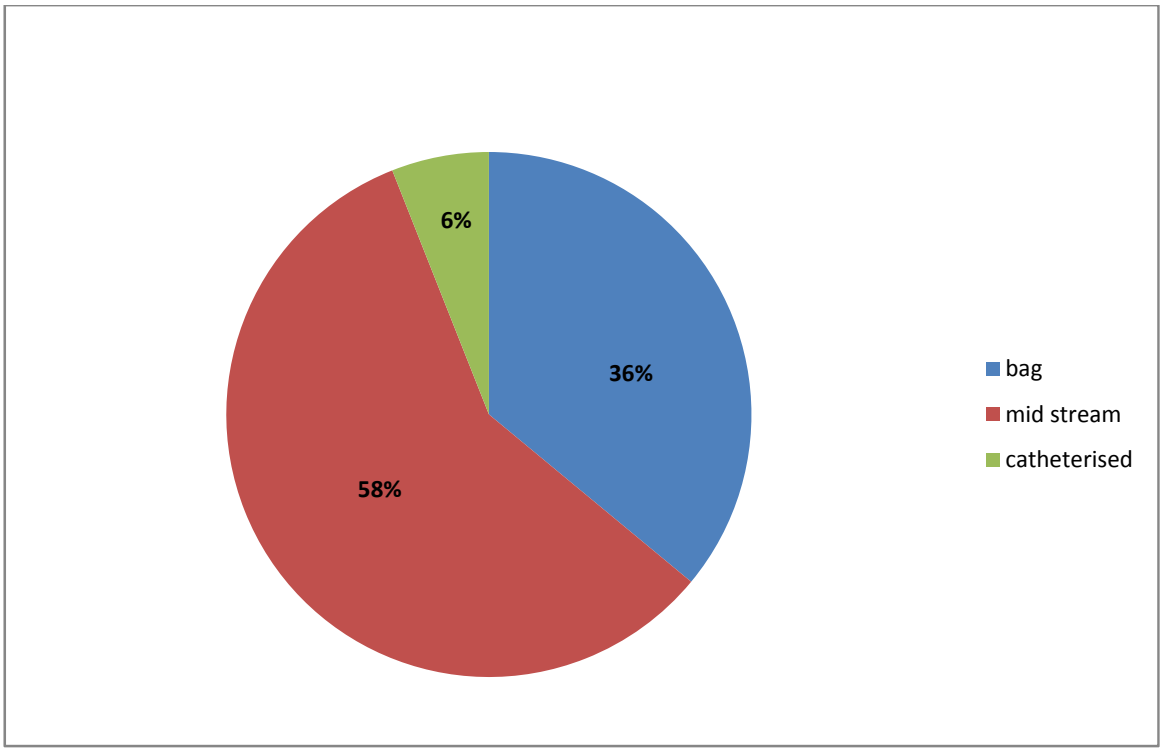
Figure37:



Majority of the patients presented with Fever as the presenting symptom, followed by dysuria, vomiting and abdominal pain. Since majority of children were < 5yrs of age, urinary symptoms constituted a comparatively less percentage.

METHOD OF URINE COLLECTION

Figure38:

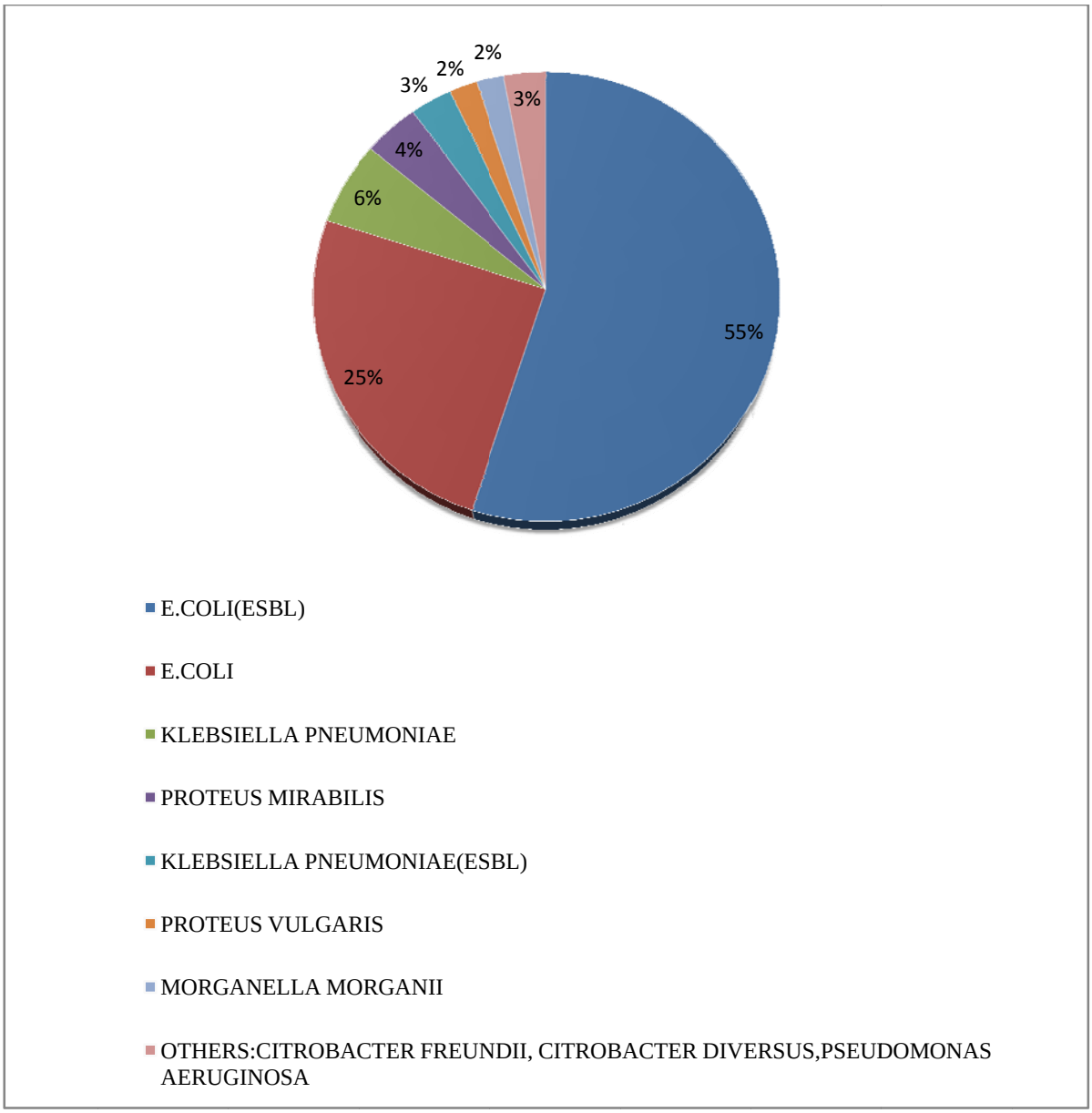


Bag method was adopted in 36%, for infants especially female infants.

Midstream and catheterized were preferred in older and cooperative children.

ORGANISM ISOLATED FROM URINE CULTURES

Figure39:



The most common organism grown was E.COLI(80%), of which ESBL were 55% and non –ESBL were 25%.

DATA ANALYSIS AND DISCUSSION:

In the present study, sensitivity, specificity, negative and positive predictive values for leucocyte esterase, pyruia, hematuria, bacteriuria, nitrites and albuminuria were analysed by comparing the test results with the gold standard norms (culture proven UTI cases and sterile culture cases).

This was done by identifying the true negative, true positive, false positive and false negative values for each variable and substituting it by the standard formula.

Each parameter was compared in both the groups to see if these parameters were significantly higher in the culture proven UTI group as compared to the sterile culture group. Further,combination of parameters were done to find out the maximum sensitivity and specificity. Age distribution of the study groups were calculated using the frequency table. Correlation of age with parameters of urine analysis were done in the culture proven UTI group and chi square was computed.Graphical illustrations were also done.

Urine analysis (atleast 1 parameter present) had a sensitivity of 83%.This was consistent with other studies. Lohr et al found sensitivity of urine analysis combining dipstick and microscopy to be 83% in children aged 1month -16 yrs.(35) Richard Bacher et al found sensitivity of urine analysis to be 82 % in

children.(21) Shaw et al reported sensitivity of combined urine dipstick and microscopy to be 83%(7).

It was observed that Leucocyte esterase had a sensitivity of 81% i.e among those who had the infection leucocyte esterase rightly detected UTI in 81%.Specificity was observed to be 90% i.e. leucocyte esterase had the ability to rightly rule out UTI in 90% of children.Positive predictive value was 89%, i.e. if the test was reported as positive, the likely chances that the patient has the infection was 89%.Negative Predictive value was 82% i.e. if a child was tested as negative the probability that the child does not have the infection was 82%.Sensitivity was consistent with studies by Gold smith et al(36), Perry et al (38), Muna et al(39) and Adeleke et al(40) where the leukocyte sensitivity ranged from 75-85% and specificity ranged from 85-95%..The study findings also were Consistent with the AAP norms.

It was observed that Nitrites had a sensitivity of 35 %.i.e. nitrites had ability to rightly detect UTI in 35% of cases and nitrites had a specificity of 99% i.e. it has the ability to rule out UTI in 99% cases. The positive predictive value was observed to be 97% i.e. the chances that child has an actual urinary infection was 97% when tested positive. The negative predictive value was observed to be 60%. i.e. the ability of the test to rule out UTI when tested negative was 60% which was low.

Walter LJM et al(43), in his study stated that nitrites had a low sensitivity(45-60%) and a higher specificity(85-98%).Gabrielle J Williams et al(44), in his study observed the sensitivity and specificity of nitrites to range from 41-57% and 96-98% respectively. Standard norms laid by AAP for the sensitivity and specificity of nitrites ranged from 15-82% and 90-100% respectively which was on par with our study findings.Although specificity of nitrites in our study were consistent with the other studies, the expected sensitivity was a little low or high as compared to other studies.Thayyil et al,found a sensitivity of 34.4% and specificity of 90.7% in a retrospective study.(41) Positive predictive value were observed to be 29.8% and negative predictive value was found to be 92.4% by Thayyil et al.(41) Similar results were reported in a study by Lejeune et al where a sensitivity was 16.2% and specificity was 97.6%(42).Muna et al(39) reported a sensitivity of 27.3% and a specificity of 100%.Although specificity of nitrites in our study were consistent with the other studies, the expected sensitivity was either in the lower limit or high as compared to other studies. This could be explained by the varied sample sizes used in different studies.

The sensitivity of pyuria to rightly diagnose UTI was observed to be 74 % and specificity was 94% i.e. the ability of the parameter in rightly ruling out UTI was found to be 94%.PPV i.e when tested positive, the likely chances that

the patient has UTI was 92.5%.NPV i.e.when tested negative, the likely chances that patient does not have UTI was 76.1%.

The sensitivity and specificity norms laid by AAP for pyuria were 73 % and 45-98%.Findings were consistent with study by Hoberman et al where sensitivity and specificity for pyuria were 54 and 96% respectively. Although specificity was in par with studies done by Matthai J et al(4), Goldsmith et al(36) and Lohr et al(35), the expected sensitivity were above 80% which can be explained by the large sample size adopted in the study.

The sensitivity of bacteriuria to rightly diagnose UTI was observed to be 63% and specificity was observed to be 96%.i.e. the likely chances in ruling out UTI is 96%. PPV was observed to be 94% and NPV was observed to be 72%i.e. the chances of patient not having infection when tested negative was 72% and chances of patient having infection when tested positive was 94%.

Studies by Lohr et al(35), Hoberman et al(37) and Matthai J et(4) al had a higher sensitivity when compared to this study due to the larger sample size. Specificity, positive and negative predictive values were either consistent or higher when compared to these studies.The sensitivity, specificity and predictive values of hematuria and albumin as single parameters were not significant. The combination of leukocyte esterase with pyuria and nitrites had the maximum sensitivity in this study.

These findings were consistent with studies by Frederick et al where combination of leukocyte esterase and or pyuria showedsensitivity and specificity of 86% and 80% respectively.Nayak et al(5) in his study concluded that the sensitivity of leukocyte esterase and/ nitrites and/or pyuria were 75%

Each of the parameters, in the culture proven UTI group were compared with age to look for any possible association. However no significant correlation was obtained except in nitrites. A significant p value showed an association between age of the child and presence of nitrites. Chi square trend was applied to assess if nitrites positivity increases as age increases which resulted in a significant p value. This can be explained by the fact that in younger children, breakdown of nitrates to nitrites by gram negative bacteria does not occur due to frequent voiding of urine. The process of breakdown to nitrites require a minimum of 4 hours of urine retention in the bladder. This also explains the low sensitivity and high specificity since UTI is more common in children <5 yrs of age.

Parameters like leukocyte esterase, albumin, pyuria, hematuria and bacteria were quantified in both groups. It was observed that pyuria in sterile culture group ranged from 6-10 pus cells/hpf as compared to majority of cases having pyuria>10 cells/hpf in the culture proven UTI. In the study by Matthai J et al(4), a cut off of 10 cells/ hpf were recommended. The drawbacks of this study were relatively small sample size and lack of standardization of urine collection due to practical difficulties.

CONCLUSION:

1. In predicting urinary tract infection, Nitrites and bacteriuria has a combined specificity of 95% and positive predictive value of 93.1%.
2. In predicting urinary tract infection, Leukocyte esterase and bacteriuria has a combined sensitivity of 82%.
3. In predicting urinary tract infection, Leukocyte esterase and nitrites has a combined sensitivity of 82% and negative predictive value of 83.3%.
4. Hematuria and albuminuria, as single parameters has poor sensitivity, specificity and predictive values.
5. Nitrites positivity increases with age.

RECOMMENDATIONS:

From this study, we conclude that a combination of nitrites and bacteriuria are reliable parameters in predicting urinary tract infection in children.

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MASTER CHART- CULTURE PROVEN UTI

S.NO	IP NO	OP NO	AGE	SEX	L.E	PY	NIT	BAC	HEM	ALB
1	I13014319		9YRS	F	P	P	P	P	P	P
2	I13014844		2YRS	F	P	P	N	P	P	N
3	I13014811		1YRS	M	P	N	P	P	P	P
4	I13016099		12YRS	M	P	P	P	N	P	P
5	I13020362	O12051039	3YRS	M	P	P	N	N	P	P
6	I13020858		1YR	F	P	P	N	P	P	N
7	I13021337		9M	M	P	P	N	P	P	P
8		O13001061	1YR	F	P	P	P	P	P	N
9		O13058495	2YRS	F	P	P	P	P	N	N
10		O13059238	3YRS	F	P	P	P	P	P	P
11	I13026076		2YRS	F	P	P	N	P	P	N
12	I13027137	O12085001	1YR	M	P	P	N	P	P	N
13	I13027532		1YR	F	P	P	N	P	P	P
14	I13028014		1YR	F	p	p	p	p	p	p
15	I13028406		7YRS	F	P	P	P	P	P	P
16	I13030002		1YR	F	p	p	p	p	p	N
17		O11067790	3YR	M	P	P	N	P	N	N
18		O12055123	2YRS	F	P	P	P	P	P	P
19		O11019193	3YRS	F	P	P	P	P	P	N
20		O11089295	2YRS	F	P	P	P	P	P	N
21	I14008923		14YRS	F	P	P	P	P	P	N
22	I13018322	O12039547	2YRS	M	P	P	N	N	P	P
23	I14019021	O12027124	9YRS	M	P	P	N	N	P	P
24	I14005565	O14006421	1YR	M	P	P	N	P	P	P
25	I140056871	O14014198	14YRS	F	N	N	P	P	N	N
26	I13032167	O13060604	1YR	M	P	P	N	P	N	N
27	I14002928	O12040828	2YRS	F	P	P	P	N	N	N
28	I13009643	O13022670	3YRS	F	P	P	P	P	P	P
29	I14000101	O13035749	1YR	M	P	P	N	N	P	N
30	I13001040	O13002110	10YRS	F	P	P	N	N	P	N
31	I13002323	O13004951	2YRS	F	P	P	N	P	N	N
32	I13029930	O13005811	1YR	F	P	P	N	N	P	N
33	I12034234	O12085631	14YRS	F	P	P	N	P	N	N
34	I14014197	O14033040	7YRS	F	P	P	P	P	N	N
35	I13024858	O12008110	2YRS	M	P	P	N	N	P	N
36	I13013053	O12080142	1YR	F	P	P	N	N	N	N
37	I13009390	O12028127	2YRS	F	P	P	N	N	P	N
38	I13036882	O13088321	2YRS	M	P	N	P	P	N	N
39	I13029340	O13069609	1YR	F	P	N	N	P	N	N
40	I13022267	O13050937	5YRS	F	P	P	N	P	P	N
41	I14001020	O14002567	1YR	M	P	P	N	N	P	N

42	I14015572	O13039405	3YRS	M	P	P	N	P	N	N
43		O14039670	5YRS	F	P	P	P	P	P	P
44	I12033686	O12014949	2YRS	F	P	P	N	P	P	P
45	I12034320	O12060593	14YRS	M	P	P	P	P	P	N
46	I12026789	O12067839	2YRS	F	P	P	P	P	P	N
47	I12033263	O08007877	10YRS	F	P	N	N	N	P	N
48	I12032859	O980 37988	15YRS	F	P	P	P	N	P	P
49	I13001572	O12093622	2YRS	M	P	N	P	P	N	N
50	I13033110	O07033630	9YRS	F	P	P	N	P	N	N
51		O13061424	1YR	M	P	P	N	P	P	P
52	I14015877	O14037756	11M	F	P	P	N	P	N	N
53	I14014589	O14034609	9M	F	P	P	N	N	P	P
54		O12087324	8YRS	F	P	P	N	P	P	N
55	I14011784	O14000780	8M	M	P	P	N	P	P	P
56	I13026411	O13049474	1YR	F	P	P	N	P	P	P
57	I14016414	O14038880	9M	M	P	P	N	P	N	N
58	I12032828	O12064668	2YRS	M	P	P	P	P	P	P
59	I12037402	O12018533	3YRS	F	P	P	P	P	P	N
60	I12035985	O12089583	2YRS	M	P	N	P	P	N	N
61	I12029199	O12029199	10YRS	F	P	P	P	P	N	N
62		O12053577	3YRS	M	P	P	P	P	N	N
63	I12019988	O12050030	6YRS	F	P	P	P	P	P	P
64	I12035876	O12034130	2YRS	F	P	P	N	p	N	N
65	I12030547	O12077338	16YRS	M	P	P	N	P	P	P
66	I12032811	O12082276	2YRS	F	P	P	N	P	N	N
67	I12021394	O11017904	3YRS	F	P	P	N	N	P	P
68	I12022251	O12000090	2YRS	M	P	P	N	P	N	P
69		O12040095	2YRS	F	P	P	P	P	P	N
70	I13005904	O12037392	2YRS	M	P	P	N	P	N	N
71	I13011733	O13025272	3YRS	M	P	p	P	P	N	N
72	I13013876	O13031705	2YRS	M	P	N	P	P	N	N
73	I14019928	O08026438	6YRS	F	P	P	N	P	P	P
74	H14004033	O14049410	1YR	F	P	P	P	P	P	N
75	I14019270	O08046377	16YRS	F	P	P	N	P	P	P
76	I14021171	O13068454	11M	F	P	P	N	P	N	N
77	I12028637	O12050668	14YRS	M	P	P	P	N	P	N
78	I12027330	O06035381	8YRS	M	P	P	P	P	P	N
79	I12028514		6YRS	M	P	P	N	N	P	P
80	I14018301	O13065226	1YR	F	P	P	N	N	P	N
81	I14012619	O13006986	2YRS	M	N	N	N	N	N	N
82	I14009274	O14021914	1YR	M	N	N	N	N	N	N
83	I14004879	O14011868	1YR	M	N	N	N	N	N	N
84	I13034656		3YRS	F	N	N	N	N	N	N

85	I13032530	O12054856	2YRS	F	N	N	N	N	N	N
86	I13030764	O13073241	1YR	M	N	N	N	N	N	N
87	I13031140	O13074250	11M	F	N	N	N	N	N	N
88		O14047099	9M	M	P	P	N	P	P	P
89	I14019616	O14046258	1YR	M	P	P	N	P	N	N
90	I14014315	O13027267	1YR	M	N	N	N	N	N	N
91	I13022893	O13053951	1YR	F	N	N	N	N	N	N
92	I12031281		11YRS	F	N	N	N	N	N	N
93	I12024186		2YRS	M	N	N	N	N	N	N
94	I12012793		3YRS	M	N	N	N	N	N	N
95	I13005131		4YRS	F	N	N	N	N	N	N
96	I13009401		5YRS	F	N	N	N	N	N	P
97	I13022128	O13051534	2YRS	M	N	N	N	N	N	N
98	I13033994	O13081017	8YRS	F	N	N	N	N	P	N
99	I12031904	O12080133	6YRS	M	N	N	N	N	N	N
100	I13001553	O12012251	8YRS	M	N	N	N	N	P	P

MASTER CHARTS- QUANTITATIVE REPRESENTATION OF CULTURE PROVEN UTI:

S.No	IP NO	OP NO	AGE	SEX	L.E	PY	NIT	BAC	HEM	ALB
1	I13014319		9YRS	F	3+	>50	P	3+	6	1+
2	I13014844		2YRS	F	3+	21-30	N	2+	9	N
3	I13014811		1YRS	M	1+	N	P	2+	8	3+
4	I13016099		12YR	M	3+	>50	P	N	6	3+
5	I13020362	O12051039	3YRS	M	3+	21--30	N	N	11--20	1+
6	I13020858		1YR	F	3+	21--30	N	1+	11--20	N
7	I13021337		9M	M	1+	11--20	N	1+	11--20	3+
8		O13001061	1YR	F	2+	>50	P	3+	11--20	N
9		O13058495	2YRS	F	3+	>50	P	3+	N	N
10		O13059238	3YRS	F	3+	31--40	P	1+	41--50	3+
11	I13026076		2YRS	F	3+	11--20	N	1+	11--20	N
12	I13027137	O12085001	1YR	M	2+	11--20	N	2+	6	N
13	I13027532		1YR	F	3+	21--30	N	2+	21--30	2+
14	I13028014		1YR	F	3+	41--50	P	3+	6	3+
15	I13028406		7YRS	F	1+	11--20	P	2+	41--50	2+
16	I13030002		1YR	F	3+	>50	P	3+	8	N
17		O11067790	3YR	M	3+	8	N	1+	N	N
18		O12055123	2YRS	F	3+	>50	P	4+	6	1+
19		O11019193	3YRS	F	3+	31-40	P	2+	6	N
20		O11089295	2YRS	F	2+	11--20	P	1+	6	N
21	I14008923		14YRS	F	3+	11--20	P	2+	8	N
22	I13018322	O12039547	2YRS	M	1+	31--40	N	N	>50	3+
23	I14019021	O12027124	9YRS	M	1+	11--20	N	N	11--20	1+
24	I14005565	O14006421	1YR	M	2+	41-50	N	3+	6	N
25	I14005687	O14014198	14YR	F	N	N	P	3+	N	N
26	I13032167	O13060604	1YR	M	2+	>50	N	1+	N	N
27	I14002928	O12040828	2YRS	F	2+	11--20	P	N	N	N
28	I13009643	O13022670	3YRS	F	2+	31--40	P	1+	8	1+
29	I14000101	O13035749	1YR	M	3+	>50	N	N	6	N
30	I13001040	O13002110	10YR	F	1+	11--20	N	N	11--20	N
31	I13002323	O13004951	2YRS	F	2+	11--20	N	4+	N	N
32	I13029930	O13005811	1YR	F	3+	21-30	N	N	6	N
33	I12034234	O12085631	14YR	F	1+	8	N	1+	N	N
34	I14014197	O14033040	7YRS	F	2+	11—20	P	2+	N	N
35	I13024858	O12008110	2YRS	M	2+	>50	N	N	6	N
36	I13013053	O12080142	1YR	F	3+	8	N	N	N	N
37	I13009390	O12028127	2YRS	F	2+	31--40	N	N	10	N
38	I13036882	O13088321	2YRS	M	2+	N	P	1+	N	N
39	I13029340	O13069609	1YR	F	2+	N	N	1+	N	N
40	I13022267	O13050937	5YRS	F	2+	>50	N	1+	8	N
41	I14001020	O14002567	1YR	M	2+	11--20	N	N	10	N

42	I14015572	O13039405	3YRS	M	1+	>50	N	2+	N	N
43		O14039670	5YRS	F	2+	21--30	P	3+	21--30	1+
44	I12033686	O12014949	2YRS	F	1+	>50	N	2+	21--30	2+
45	I12034320	O12060593	14YR	M	1+	11--20	P	1+	8	N
46	I12026789	O12067839	2YRS	F	1+	11--20	P	1+	10	N
47	I12033263	O08007877	10YR	F	1+	N	N	N	21-30	N
48	I12032859	O980 37988	15YRS	F	3+	21-30	P	N	8	2+
49	I13001572	O12093622	2YRS	M	1+	N	P	2+	N	N
50	I13033110	O07033630	9YRS	F	3+	>50	N	2+	N	N
51		O13061424	1YR	M	3+	>50	N	3+	6	1+
52	I14015877	O14037756	11M	F	3+	21	N	1+	N	N
53	I14014589	O14034609	9M	F	1+	11--20	N	N	21-30	1+
54		O12087324	8YRS	F	2+	11--20	N	2+	11--20	N
55	I14011784	O14000780	8M	M	1+	21--30	N	1+	6	1+
56	I13026411	O13049474	1YR	F	3+	31-40	N	3+	8	1+
57	I14016414	O14038880	9M	M	3+	21	N	3+	N	N
58	I12032828	O12064668	2YRS	M	3+	11--20	P	2+	10	2+
59	I12037402	O12018533	3YRS	F	2+	8	P	2+	6	N
60	I12035985	O12089583	2YRS	M	2+	N	P	1+	N	N
61	I12029199	O12029199	10YR	F	2+	11--20	P	3+	N	N
62		O12053577	3YRS	M	1+	31--40	P	2+	N	N
63	I12019988	O12050030	6YRS	F	2+	11--20	P	2+	6	1+
64	I12035876	O12034130	2YRS	F	2+	11--20	N	2+	N	N
65	I12030547	O12077338	16YR	M	3+	41-50	N	2+	41--50	2+
66	I12032811	O12082276	2YRS	F	3+	11--20	N	2+	N	N
67	I12021394	O11017904	3YRS	F	1+	9	N	N	6	2+
68	I12022251	O12000090	2YRS	M	1+	8	N	1+	N	2+
69		O12040095	2YRS	F	3+	>50	P	3+	21--30	N
70	I13005904	O12037392	2YRS	M	3+	11--20	N	2+	N	N
71	I13011733	O13025272	3YRS	M	2+	11--20	P	3+	N	N
72	I13013876	O13031705	2YRS	M	2+	8	P	2+	N	N
73	I14019928	O08026438	6YRS	F	2+	11--20	N	2+	11--20	1+
74	H14004033	O14049410	1YR	F	3+	>50	P	2+	6	N
75	I14019270	O08046377	16YR	F	2+	11--20	N	1+	N	1+
76	I14021171	O13068454	11M	F	1+	8	N	1+	N	N
77	I12028637	O12050668	14YR	M	2+	41-50	P	N	8	N
78	I12027330	O06035381	8YRS	M	1+	21--30	P	3+	8	N
79	I12028514		6YRS	M	1+	8	N	N	9	1+
80	I14018301	O13065226	1YR	F	3+	11--20	N	N	11--20	N
81	I14012619	O13006986	2YRS	M	N	N	N	N	N	N
82	I14009274	O14021914	1YR	M	N	N	N	N	N	N
83	I14004879	O14011868	1YR	M	N	N	N	N	N	N
84	I13034656		3YRS	F	N	N	N	N	N	N

85	I13032530	O12054856	2YRS	F	N	N	N	N	N	N
86	I13030764	O13073241	1YR	M	N	N	N	N	N	N
87	I13031140	O13074250	11M	F	N	N	N	N	N	N
88		O14047099	9M	M	3+	>50	N	2+	11--20	1+
89	I14019616	O14046258	1YR	M	2+	11--20	N	3+	N	N
90	I14014315	O13027267	1YR	M	N	N	N	N	N	N
91	I13022893	O13053951	1YR	F	N	N	N	N	N	N
92	I12031281		11YRS	F	N	N	N	N	N	N
93	I12024186		2YRS	M	N	N	N	N	N	N
94	I12012793		3YRS	M	N	N	N	N	N	N
95	I13005131		4YRS	F	N	N	N	N	N	N
96	I13009401		5YRS	F	N	N	N	N	N	1+
97	I13022128	O13051534	2YRS	M	N	N	N	N	N	N
98	I13033994	O13081017	8YRS	F	N	N	N	N	8	N
99	I12031904	O12080133	6YRS	M	N	N	N	N	N	1+
100	I13001553	O12012251	8YRS	M	N	N	N	N	8	1+

STERILE GROUP WITH QUANTITATIVE REPRESENTATION OF POSITIVE RESULTS

	IP NO	OP NO	AGE	SEX	L.E	PY	NIT	BAC	HEM	ALB
1	I13018824	O13043241	10YR	M	N	N	N	N	N	N
2	I13017771	O13040748	7YR	F	N	N	N	N	N	N
3	I13017190	O13039426	16YR	M	N	N	N	1+	6--8	1+
4	I13016376	O13037448	3YR	F	N	N	N	N	N	N
5	I13014647	O13033424	6YR	F	N	N	N	N	N	N
6	I13013913	O13031797	1YR	M	N	N	N	N	N	N
7	I13011603	O13027206	2YR	F	N	N	N	N	N	N
8	I13017601	O12068938	2YR	F	N	N	N	N	N	N
9	I14001076		5YR	F	N	N	N	N	N	N
10	I14000658		5YR	F	N	N	N	N	N	N
11	I14000663		2YR	M	N	N	N	N	N	N
12	I14000232		5YR	F	N	N	N	N	N	N
13	I14000081		12Y	F	N	N	N	N	N	N
14	I13038981		3YR	M	N	N	N	N	N	N
15	I13036780		1YR	M	N	N	N	N	N	N
16	I13035431		5YR	M	N	N	N	N	N	N
17	I13033452		3YR	M	N	N	N	N	N	N
18	I13032960		10YR	M	N	N	N	N	N	N
19	I13032210		6YR	F	N	N	N	N	N	N
20	I13031864		2YR	F	N	N	N	N	N	N
21	I13031226		4YR	F	N	N	N	N	N	N

22	I13030189		4YR	F	N	N	N	N	N	N
23	I13028732		7YR	M	N	N	N	N	N	N
24	I13021320		1yr	M	N	N	N	N	N	N
25	I13021296		11YR	F	N	N	N	N	N	N
26	I13028186		9YR	M	N	N	N	N	N	N
27	I13026156		6YR	M	N	N	N	N	N	N
28	I13025782		6YR	M	N	N	N	N	N	N
29	I13025456		11YR	M	N	N	N	N	N	N
30	I13024534		8YR	F	N	N	N	N	N	N
31	I13020828		2YR	M	N	N	N	N	N	N
32	I13031886		3YR	F	N	N	N	N	N	N
33	I13021335		2YR	F	N	N	N	N	N	N
34	I13018863		2YR	M	N	N	N	N	N	N
35	I13011000		3YR	M	N	N	N	N	N	1+
36	I13011922		2YR	M	N	N	N	N	6--8	N
37	I13031320		14YR	M	N	N	N	N	6--8	N
38	I13026088		1YR	F	3+	6--8	N	N	6--8	N
39	I13025113		6YR	F	N	N	N	N	8--10	N
40	I13024534		8YR	F	2+	N	P	N	8--10	N
41	I13026892		1YR	M	N	N	N	N	N	1+
42	I13027301		6YR	F	N	N	N	N	N	1+
43	I13028057		1YR	M	N	N	N	N	6	N
44	I13021821		1YR	M	N	N	N	N	8--10	1+
45	I13029273		3YR	F	N	N	N	N	6--8	N
46	I13025982		6YR	F	N	N	N	N	N	N
47	I13022681		13YR	M	1+	N	N	N	8--10	N
48	I13021489		13YR	F	N	N	N	N	N	N
49	I13020176		7YR	F	N	N	N	N	8--10	1+
50	I13019240		6YR	F	N	N	N	N	N	N
51	I13017638		14YR	F	N	N	N	N	N	N
52	I13021413		13YR	M	N	N	N	1+	6--8	N
53	I13017405		8YR	M	N	N	N	N	N	N
54	I13016996		5YR	M	N	N	N	N	N	N
55	I13016843		7YR	M	N	N	N	N	N	N
56	I13016347		14YR	F	N	N	N	2+	6--8	N
57	I13016174		2YR	M	N	N	N	N	N	N
58	I13014094		5YR	M	1+	5--6	N	N	N	N
59	I13013427		10YR	M	N	N	N	N	N	N
60	I13012852		4YR	M	N	N	N	N	11--12	1+
61	I13012891		2YR	F	1+	6--8	N	N	N	N
62	I13013186		9YR	M	N	N	N	N	8	2+
63	I13012434		1YR	M	N	N	N	N	N	N
64	I13004605		4YR	F	N	N	N	N	8--10	N
65	I13002755		6YR	M	N	N	N	N	N	N

66	I13002877		12yr	m	N	N	N	N	N	N
67	I13002307		9YR	M	N	N	N	N	8--10	N
68	I13004933		10YR	F	2+	8--10	N	N	N	N
69	I13001797		1YR	F	N	N	N	N	N	N
70	I13007606		2YR	F	N	N	N	N	N	N
71	I13005916		9YR	F	N	N	N	N	N	N
72	I13005273		13YR	M	N	N	N	N	11--15	N
73	I13010860		5YR	F	N	N	N	N	8--10	1+
74	I13000488		8YR	F	N	N	N	1+	11--12	1+
75	I13000901		9YR	M	N	N	N	N	N	N
76	I13001696		5YR	M	N	N	N	N	N	1+
77	I13009390		8YR	F	2+	N	N	N	6--8	N
78	I13003905		2YR	M	N	N	N	N	N	N
79	I13010922		2YR	M	N	N	N	N	N	N
80	I13000929		3YR	F	N	N	N	N	8--10	N
81	I13007857		2YR	F	N	N	N	N	N	N
82	I13008061		10YR	F	N	N	N	N	N	N
83	I13008202		3YR	M	1+	N	N	N	11--12	1+
84	I13029586		1YR	F	2+	N	N	N	8--10	1+
85	I13038091		4YR	F	N	N	N	N	N	N
86	I13017175		2YR	M	N	N	N	N	N	N
87	I13012915		15M	M	N	N	N	N	N	N
88	I13003936		3YR	M	N	N	N	N	N	N
89	I13004144		9YR	M	N	N	N	N	N	N
90	I13004153		6YR	M	N	N	N	N	N	N
91	I13005139		4YR	F	N	N	N	N	N	N
92	I13005015		2YR	M	N	N	N	N	N	N
93	I13010986		10YR	F	N	N	N	N	N	N
94	I13000133		4YR	F	N	N	N	N	N	N
95	I13005218		5YR	M	N	N	N	N	6--8	1+
96	I13000270		4YR	M	2+	8---10	N	N	N	N
97	I13003057		4YR	M	N	N	N	N	N	N
98	I13003235		11YR	F	N	N	N	N	N	N
99	I14024898		10YR	F	N	N	N	N	N	N
100	I14022287		1YR	M	N	6--8	N	N	8	N

KEY WORDS

UTI – URINARY TRACT INFECTION

PY-PYURIA

NIT-NITRITES

BAC-BACTERIURIA

ALB-ALBUMINURIA

HEM-HEMATURIA

VUR-VESICOURETERIC REFLUX

USG-ULTRASOUND

P-POSITIVE

N-NEGATIVE

Hpf-high power field

NPV-NEGATIVE PREDICTIVE VALUE

PPV-POSITIVE PREDICTIVE VALUE